EXHIBIT E

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF NEW YORK

SAMUEL M. ROBERTS,

Plaintiff,

vs.

LOS ALAMOS NATIONAL SECURITY, LLC, AWE, PLC., MASSACHUSETTS INSTITUTE OF TECHNOLOGY,

Defendants,
Third-Party Plaintiffs,

vs.

UNIVERSITY OF ROCHESTER

Third-Party Defendant.

SECOND SUPPLEMENTAL RESPONSE TO PLAINTIFF'S DEMAND FOR DISCOVERY

Civil No. 11 CV 6206L

Defendant/Third-Party Plaintiff, Los Alamos National Security, LLC (hereinafter "Los Alamos"), by and through its attorneys, Woods Oviatt Gilman LLP, provides its Second Supplemental response to Plaintiff's First Demand for Discovery and Inspection, as follows:

PRELIMINARY STATEMENT

By responding to Plaintiff's Demand, Defendant Los Alamos does not waive any objections it may have regarding the use of information regarding the truth or accuracy of any characterizations or assumptions contained in the Demand. Defendant Los Alamos reserves its rights to make all objections identified herein or object on other grounds as to the use or admissibility of the information provided, in whole or in part, or the subject matter covered thereby, in any proceeding or trial or in any other action. Defendant Los Alamos reserves its right to object on any and all proper grounds and it, in no way, admits as to the authenticity, competency, relevance, materiality or admissibility of any of the information provided herein.

Woods Oviatt Gilman LLP
700 Crossroads Building
2 State Street
Rochester, New York 14614

The responses of Defendant Los Alamos are, and will be, based upon information acquired thus far, and Defendant Los Alamos reserves the right to amend or supplement its responses in accordance with the Federal Rules of Civil Procedure and the Local Rules of this Court. By responding to this Demand, Defendant Los Alamos does not waive any objections it may have with regard to Plaintiff's use of the information or regarding the truth or accuracy of any characterizations or assumptions contained in Plaintiff's Demand. Defendant Los Alamos reserves its right to make all objections identified herein or object on the grounds, comment as to the use or admissibility of information provided, in whole or in part, or the subject matter covered thereby, in any proceeding or trial or any other action. Defendant Los Alamos reserves its right to object on any and all proper grounds and it in no way admits the authenticity, competency, relevance, materiality or admissibility of any of the information provided herewith.

The responses of Defendant Los Alamos are, and will be, based on the information acquired thus far, and it reserves the right to supplement its responses in accordance with the Federal Rules of Civil Procedure and the local rules of this Court.

General Objections

1. Defendant Los Alamos objects to each request, instruction or definition to the extent that any of them seek to impose any obligation beyond that required by the Federal Rules of Civil Procedure or the Local Rules of this Court.

2. Defendant Los Alamos objects to each request to the extent it could be construed to seek information which may be covered by the attorney-client privilege, the work-product privilege, or any other applicable privilege doctrine.

Woods Oviatt Gilman LLP
700 Crossroads Building
2 State Street
Rochester, New York 14614

3. Defendant Los Alamos objects to each request to the extent that it may be construed to seek information which is proprietary and/or confidential or otherwise restricted from disclosure to the general public.

4. Defendant Los Alamos objects to each demand that does not specify a time frame on the ground that such demands are overbroad and not reasonably calculated to lead to the discovery of admissible evidence.

5. Defendant Los Alamos objects to each demand to the extent that it purports to require the discovery of information not within its possession, custody, or control.

6. Defendant Los Alamos objects to any interpretation of each demand to the extent that it calls for information that does not refer to or relate to matters alleged in the above-captioned action.

7. Defendant Los Alamos objects each demand to the extent the Notice to Produce seeks information that is neither relevant nor reasonably calculated to lead to the discovery of admissible evidence.

9. Unless otherwise specified, all general objections apply to each numbered answer as if each general objection was specifically set forth therein.

SECOND SUPPLEMENTAL RESPONSES TO SPECIFIC DEMANDS

1. See materials attached as ***Exhibit A***.

2. See materials attached as ***Exhibit A***.

The Defendant/Third-Party Plaintiff Los Alamos National Security, LLC reserves the right to amend and/or supplement its responses to these requests as may be appropriate.

Dated: October 5, 2012
Rochester, New York

WOODS OVIATT GILMAN LLP

By: ______________________
Beryl Nusbaum, Esq.
Greta K. Kolcon, Esq.
Attorneys for Defendant/Third-Party Plaintiff Los Alamos National Security LLC
700 Crossroads Building
2 State Street
Rochester, New York 14614
585.987.2800

TO: Louis J. Micca, Esq.
Attorneys for Plaintiff
11 State Street
Pittsford, New York 14534
585.899.6031

HOLLAND & KNIGHT, LLP
Christine Tramontano, Esq.
Attorneys for AWE, Plc.
31 West 52nd Street
New York, New York 10019

GEIGER AND ROTHENBERG, LLP
David Rothenberg, Esq.
Attorneys for Massachusetts Institute of Technology
45 Exchange Street, Suite 800
Rochester, New York 14614

WARD, GREENBERG, HELLER & REIDY, LLP
Eric J. Ward, Esq.
Attorneys for University of Rochester
300 State Street, 6th Floor
Rochester, New York 14614

CERTIFICATE OF SERVICE

I, GRETA K. KOLCON, ESQ., attorney of record for Defendant and Third-Party Plaintiff, Los Alamos National Security, LLC, in the above-styled and referenced matter, do hereby certify that on October 5, 2012, the annexed Second Supplemental Response to Plaintiff's Demand for Discovery was served via United States Postal Service and e-mail on the following attorneys of record:

LOUIS J. MICCA, ESQ.
Attorneys for Plaintiff, Samuel M. Roberts
11 State Street
Pittsford, New York 14534
lmicca@msn.com

GEIGER and ROTHENBERG, LLP
David Rothenberg, Esq.,of counsel
Attorneys for Defendant,
Massachusetts Institute of Technology
45 Exchange Street, Suite 800
Rochester, New York 14614
drothenberg@geigroth.com

HOLLAND & KNIGHT LLP
Sean C. Sheely, Esq., of counsel
Christine Tramontano, Esq., of counsel
Philip T. Evans, Esq., of counsel
Attorneys for Defendant, AWE, PLC
31 West 52nd Street
New York, New York 10019
sean.sheely@hklaw.com
christine.tramontano@hklaw.com
philip.evans@hklaw.com

WARD GREENBERG HELLER & REIDY LLP
Eric J. Ward, Esq., of counsel
Heidi S. Martinez, Esq., of counsel
William R. Leinen, Esq., of counsel
Attorneys for Third-Party Defendant,
University of Rochester
300 State Street
Rochester, New York 14614
eward@wardgreenberg.com
hmartinez@wardgreenberg.com
wleinen@wardgreenberg.com

THIS, the 5th day of October, 2012.

WOODS OVIATT GILMAN LLP

By: ______________________

Greta K. Kolcon, Esq.
Beryl Nusbaum, Esq.
Attorneys for Defendant and Third-Party Plaintiff, Los Alamos National Security
700 Crossroads Building
2 State Street
Rochester, New York 14614
585.987.2800
gkolcon@woodsoviatt.com
bnusbaum@woodsoviatt.com

EXHIBIT A

OMEGA Shot
Request Form

UR LLE

Go To RID#

This RID#: 25865
Last Modified: 08-Aug-2008 11:49:53

General > Drivers > Target > Beams > TIM > Fixed > Neutronics

Facility Status
Comments/Problems

XOPS Beamlines

Help

Neutron Diagnostic Configuration **(Help)**

Select Primary Radiation: DT

Enter expected (not estimated) yield 5.00e+12

Defaults **- Neutron detectors recommended for the above parameters**

- Selections may be edited.
- Press Update to save the final configuration.

Diagnostic Description	Priority	
Activation Retractor Copper (ACTR)	Primary	Set up
CVD Neutron Bang-Time Detector 1 (CVDNBT)		
H10 CVD at 5.0m 5.0MCVD (H10CVD)		
H10 Photo Diode at 5.3m PDD99 (PDC)		
H10 Photo Diode at 5.3m PDO40 (PDC)		
H15 Re-entrant Tube CVD 1-6 (H15DCVD)		Set up
High Yield Neutron Bang-Time Detector 1 (HYNBT)	Secondary	
LANL LDRD Beta Mix P4G (BMIX)		Set up
LANL LDRD Beta Mix SCNT (BMIX)		Set up
LANL LDRD Beta Mix SiTel (BMIX)		Set up
NIF nTOF detector 1 (NIF-NTOF)		Set up
Neutron Bang-Time Detectors LLE (BTDET)		
Neutron Temporal Diagnostic 1 (NTD)	Primary	Set up
P11-NBT4.5m 1 (P11_NBT45)		Set up
Particle Temporal Diagnostic N (PTD)		**Select PTD on TIM 5**
Scintillator Counter A 3M LARD (SCC)		
Scintillator Counter B 2x2 (SCC)		
Scintillator Counter C 3M NTOF (SCC)		
Scintillator Counter D 5.4M NTOF (SCC)		

Scintillator Counter E 1.7M NTOF (SCC)	
Scintillator Counter F 12M NTOF L (SCC)	Primary
Scintillator Counter G 12M NTOF H (SCC)	Primary

nTOF LaCave Diagnostics

Set up

Setup sheets are not required for the NIS diagnostics.

Comments:

Reminder: Use the NTD Set up page to define the NTD configuration.

Campaign Editor | Drivers Editor | Beam Editor | SRF Auditor

Update | Copy ... | Reports | Station Reports

To: Vladimir Glebov <vgle@lle.rochester.edu>
From: "Hans W. Herrmann" <herrmann@lanl.gov>
Subject: DTRat
Cc: Colin Horsfield
Bcc:
Attached:

Vladimir,

We were planning to put PTD in TIM-5 on Aug 6, but MIT does not want to use it in DT. So TIM-5 is now available for your use. I tentatively placed CVD Diamond Detector - 1 in TIM-5. You have PI access to the SRF's if you would like to change this. So far, they are RID's 25865 (DT/3He) and 26170 (D2/3He)

We would like to run the light pipe with CO2 and a fast PMT/SCD scope like we did last year. I expect Colin to be interacting with you on this again.

thanks,
Hans

Hans W. Herrmann, Ph.D., CDR (Ret., USNR)
P-24 Plasma Physics, M/S E526
Los Alamos National Laboratory
Los Alamos, NM 87545
herrmann@lanl.gov
505-665-5075
fax: 667-0405

if Foreign correspondence: TSPA or Correspondence

[X] Unrestricted (P-DIV-POL-020, Att. 1, Rev. 0, 28 March 2006)
[ ] - Non-Technical Correspondence
[X] - Technical Correspondence
LA-UR [ ] - LA-CP [ ] - LALP [ ]
Reviewed [ ] ADC -
DUSA ADTO [ ]
DUSA HEP [ ]

To: vladimir Glebov <vgle@lle.rochester.edu>, wilke@lanl.gov
Subject: SRF Setups
X-Attachments: C:\Documents and Settings\121744.WIN\My Documents\GCD\GCD Data\GCD_Aug08\DTRat'08 Shot List.xls;

Vladimir & Mark,

I've attached the Shot List for DTRat'08 coming up on Aug 6. DD-RIC & NIS are listed as Ride Alongs on the SRFs. I would appreciate it if you could up date the setup sheets for these diagnostics by COB on Monday.

Vladimir- I've also tentatively included HYNTD as a primary diagnostic for the DT/3He shots (CO2 mode) and secondary for D2/3He shots (Scintillator). We can discuss next week.

thanks,
Hans

Hans W. Herrmann, Ph.D., CDR (Ret., USNR)
P-24 Plasma Physics, M/S E526
Los Alamos National Laboratory
Los Alamos, NM 87545
herrmann@lanl.gov
505-665-5075
fax: 667-0405

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Reviewed [ ] ADC -
DUSA ADTO [ ]
DUSA HEP [ ]

To: Vladimir Glebov <vgle@lle.rochester.edu>
From: "Hans W. Herrmann" <herrmann@lanl.gov>
Subject: [Fwd: BetaMix - 9/18/08]
Cc: Paul Keiter <pkeiter@lanl.gov>
Bcc:
Attached:

Vladimir,

Now that BetaMix has been moved to September, what is planned for Aug 7? Will it still be high yield? If so, do you know if it might be possible to swap this day with the DTRat shot day planned for Aug 6. I had been talking to Gary about this possibility so that GCD could have a day to ride-along before a dedicated shot day.

thanks,
Hans

-------- Original Message --------
Subject: BetaMix - 9/18/08
Date: Mon, 07 Jul 2008 14:38:06 -0400
From: John Soures <jsou@lle.rochester.edu>
To: gpgrim@lanl.gov
CC: slou@lle.rochester.edu, ssta@lle.rochester.edu, smor@lle.rochester.edu, pien@lle.rochester.edu, csan@lle.rochester.edu, ddm@lle.rochester.edu, dmay@lle.rochester.edu, pmck@lle.rochester.edu, thorp@lle.rochester.edu, jkel@lle.rochester.edu, mbon@lle.rochester.edu, dhar@lle.rochester.edu, jlab@lle.rochester.edu, jste@lle.rochester.edu, jsou@lle.rochester.edu, pkeiter@lanl.gov

The OMEGA Scheduling Committee approved the rescheduling of your previously scheduled BetaMix experiment. The experiment is now scheduled to be conducted on OMEGA on 18 September, 2008.

John M. Soures
Manager, National Laser Users Facility
Laboratory for Laser Energetics
University of Rochester
250 East River Rd.
Rochester, NY 14623
(585)-275-3866
(585)-275-5960 (FAX)
jsou@lle.rochester.edu

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Gary P. Grim

Neutron Science & Technology
Los Alamos National Laboratory
P.O. Box 1663, MS H803
Los Alamos, NM 87545
Phone (505) 667-8985
Fax (505) 665-4121
E-mail mailto:gpgrim@lanl.gov

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John A. Oertel
Team Leader, Diagnostic and Systems Engineering
Los Alamos National Laboratory
POB 1663, MS-E526
Los Alamos, NM 87545
505-665-3246 Phone
505-665-4409 FAX
505-949-2153 Pager

Hans W. Herrmann, Ph.D., CDR (Ret., USNR)
P-24 Plasma Physics, M/S E526
Los Alamos National Laboratory
Los Alamos, NM 87545
herrmann@lanl.gov
505-665-5075
fax: 667-0405

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Reviewed [ ] ADC -
DUSA ADTO [ ]
DUSA HEP [ ]

John A. Oertel
September 5, 2008
Los Alamos National Laboratory
Oertel's eye-witness account of LLE accident August 6, 2008

I was in the Omega/LLE control room at the ESO desk at ~6:30 PM retrieving trigger timing numbers for the NIS diagnostic with two ESO technicians when we heard a loud bang noise, followed by the hissing noise of venting gas coming from the target bay. The two technicians were listening on communication headsets to the loud noise and yelling of confusion from the target technicians trying to figure out what had happened. The primary concern at that point was the apparent loss of target chamber vacuum as seen from the vacuum gauge reading on the ESO control panel. Approximately 15 seconds after we heard the loud bang, one of the target technicians came running out of the target bay into the control room and instructed the shot director to call 911 and proclaimed, "we have a man down in the target bay". The shot director immediately called 911 and began relaying patient information to the 911 operators. At that point it wasn't exactly clear how badly the victim was injured and whether he was unconscious or not. The target technician actually demonstrated the position the victim was in by laying in the recovery position on the floor.

I then walked into the user room and mentioned to David Clark of P-23 (knowing that David, like myself was trained as a 1st responder) that we may want to be on stand-by for help to the victim. My assumption at this point that the victim most likely had a head wound, known to bleed a lot, and that though there was probably a bloody face with a lot of blood around there was no immediate danger of loss of life.

David and I went to the shot director and informed him and the target technician that we were 1st responders and that we were available to help. The target technician (obviously shaken by the scene) said "good, let's go". I don't remember the shot director saying anything, but he did allow us to proceed. The target technician informed David and I that others were administering CPR and we headed for the target bay. At that point the target technician said that we had to suit up in clean room clothes before we could enter into the target area. I protested repeatedly but complied to get access as soon as possible. This also reinforced my original surmising of the situation as a bloody scene, but not life threatening. I asked the target technician for a CPR barrier mask and gloves, to protect us from potential disease transmission. The technician brought us an old first aid kit that had just a few bandages and no personal protective equipment (PPE). David and I looked at each other and agreed that we would just do rescue breathing without PPE.

After continuing to protest the delay due to the requirements of having to suit up into clean room garb, we were finally allowed access into the target bay with just

coveralls, hood, facemasks and gloves, but no booties or laser safety glasses. We were told that there were no longer any eye hazards and to proceed.

Having been in the target bay many times, I led, with David and the target technician following closely behind me. When we arrived on scene, we found Sam Roberts unconscious lying in the East side of the target bay on the ground level facing up. Scott Evans (a LANL technician) and Zaheer Ali (a NSTec Operations Scientist) were administering CPR with Scott sitting by Sam's head and with Zaheer giving chest compressions. There was a considerable amount of blood surrounding Sam and there was a large angled gash across his face indicating blunt trauma. As we came into the room and to insure scène safety, I asked the group of 4 LLE target technicians that were grouped several feet to the West of the accident if there was anything else that could fall on responders. We were told the scene was safe. As David and I moved in to do a patient size up, Scott and Zaheer moved back. David checked for a pulse and proclaimed that "yes, he has a pulse". Our next concern was a clear airway, due to the significant facial blunt trauma and we were preparing to do a mouth sweep when the Rochester, NY fire department came through the door.

At that point we moved back from Sam Roberts and provided patient and situational safety information to the fire department EMT's. I stayed in the target bay for an additional ~10 minutes after Sam was moved out of the target bay. I got some absorbent towels from the target technicians to clean up the blood so that the remaining fire department responders could work safely.

In reflection, it is very unfortunate that Sam Roberts was injured, but I am very proud that the initial caregivers at Sam Roberts' side were DOE (LANL & NSTec) employees that trusted their many years of CPR training and were not afraid to do the right thing.

Lessons learned for me personally:

1. Carry my own first aid kit with me on travel.
2. Be aware of off site AED and first aid kit locations.
3. In the event of an emergency, listen objectively to the people around me, but trust my own instincts.

Hans W. Herrmann, Principal Investigator, CDR (Ret., USNR)
September 8, 2008
Los Alamos National Laboratory
Principal Investigator's account of LLE accident on August 6, 2008

On August 6, 2008, I was the Principal Investigator for the DT Ratio experimental campaign on the OMEGA laser facility. At approximately 6:30 pm, an accident occurred inside the target bay which seriously injured an LLE employee. At the time of the incident, Scott Evans (LANL) and Zaheer Ali (NSTec, LO) were performing modifications to LANL's Gas Cherenkov Detector on the upper deck of the target bay while being observed by an LLE technician escort. When they heard what sounded like an explosion, it is my understanding that the three of them went to investigate and found Sam Roberts lying in a pool of blood on the bottom deck with the LLNL/LLE "Light Pipe" diagnostic lying in a "twisted heap" near by. Apparently Sam had been struck in the face by the heavy apparatus, sustaining a deep facial laceration. The LLE escort exited the target bay to get help while Scott and Zaheer stayed with the victim to administer first aid. When they were unable to detect a pulse, Zaheer performed chest compressions while Scott maintained a clear airway and attempted to control the bleeding. Zaheer said afterward that he had administered over 200 compressions when he lost count. Scott and Zaheer maintained control of the scene for approximately 5 to 10 minutes until two additional LANL employees, John Oertel and David Clark, both trained first responders, arrived and took over administering first aid. They assessed the situation and determined that Sam did have a pulse at this point. John and David maintained control the scene for several more minutes until the Rochester emergency responders arrived on site.

Hans W. Herrmann

September's experiment, a number of imaging improvements have been initiated and thus we have high confidence for the physics experiments planned in February 2009.

[redacted]

Figure 1: Overview of the AGEX-EOS-09 target (left) and the preliminary data from shot 52215 (right).

DTrat

In August 2008, LANL continued the *DT Ratio- ^{3}He Addition* campaign, imploding glass capsules filled with DT/^{3}He using a 600 ps square laser pulse. Previous studies have looked at the effect of adding ^{3}He to the D_2-filled capsules (as a DT surrogate)- this study is the first to look at the effect on DT. The use of DT also allows the acquisition of high quality reaction histories derived from the Gas Cherenkov Detector (GCD-1). From these reaction histories, it has been determined that the addition of ^{3}He degrades the compression component of yield more than expected. This is consistent with the conclusions of the study conducted by MIT using D_2/^{3}He-filled plastic capsules (R. Rygg, et al., Phys Plasmas 13, 052702 (2006)) and LANL's Hi-Z campaign utilizing glass capsules, also filled with D_2/^{3}He (D.C. Wilson, Jrnl Phys: Conf

Ser 112 022015 (2008)). However, contrary to the MIT study, the shock component does not appear to be significantly affected.

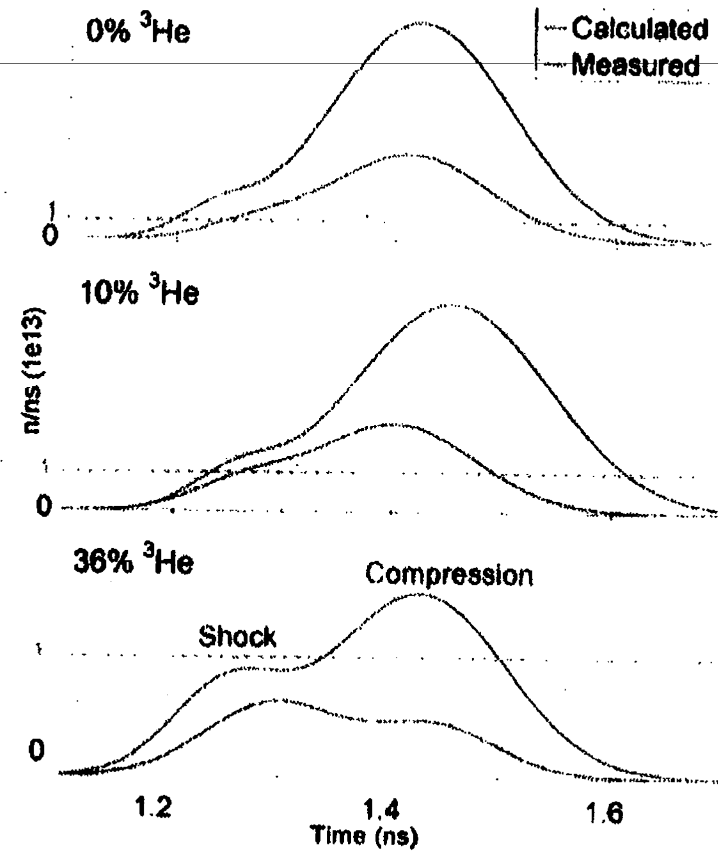

Figure 2: Calculated (convolved with residual instrument response) and measured (deconvolved GCD data) reaction histories for various ^{3}He concentrations.

Figure 2 shows the reaction histories for three concentrations of ^{3}He addition. Overall, the measured neutron yield is ~37% of a clean calculation for *each* ^{3}He concentration. However, when the histories are decomposed into Gaussian components representative of shock and

compression yields, the measured compression component goes from being a factor of three lower than calculated at 0% ^{3}He, to being a factor of five lower at 36% ^{3}He. This agrees well with the MIT study as seen in Figure 3 (the factor of 3 at 0% ^{3}He is normalized out for the DTRat data set, whereas a factor of ~2.2 is normalized out for the "Rygg" data set). In contrast, the decomposed shock component from DTRat agrees quite well with the clean calculation for all three ^{3}He concentrations as shown in Figure 4.

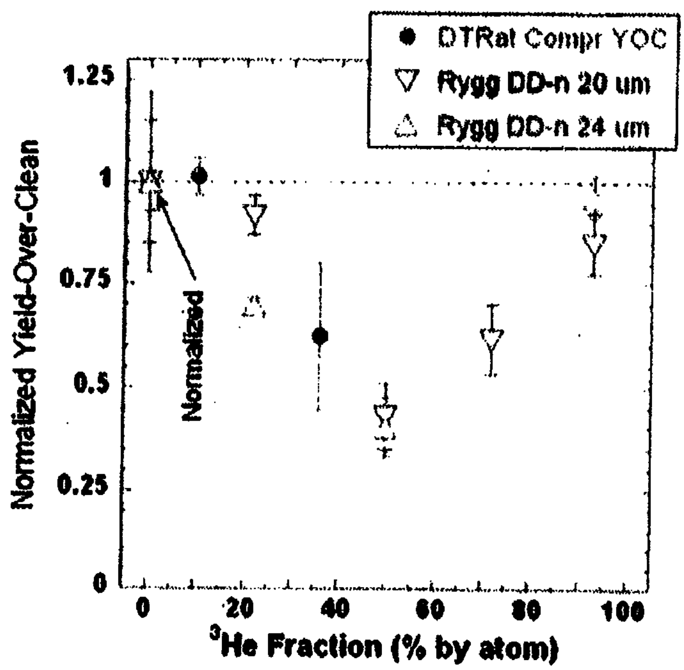

Figure 3: Scaled compression component of neutron yield normalized to one at 0% ^{3}He.

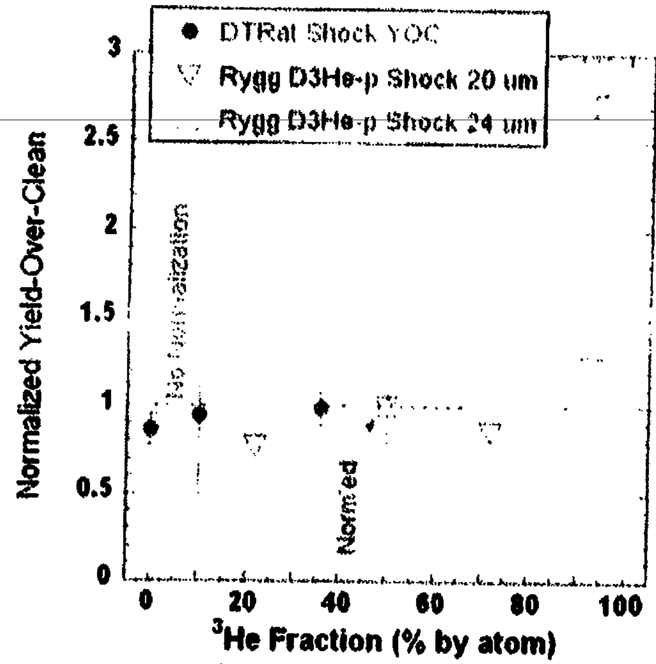

Figure 4: Scaled shock component of neutron yield normalized to one at 50% ^{3}He for "Rygg" data; no normalization for DTRat data.

Shock yield data for the 24 µm wall-thickness capsules from MIT's "Rygg" study exhibit a parabolic dependence on ^{3}He fraction, with the minimum occurring near 50% ^{3}He, similar to what was observed for the compression component. The data set for 20 µm thick walls, however, does not appear to support this trend. We suspect the degraded yield anomaly arises only after the shock has reflected from the center and has hit the incoming shell. After such time, the shock yield is diminishing while the compression yield is rising. X-ray imaging and ρR data from DTRat, Hi-Z and the MIT study support the hypothesis that capsules with ~50% ^{3}He aren't as

compressed at the time of peak neutron production rate during the compression phase as those without ^{3}He (or those with nearly pure ^{3}He from the MIT study). It is not understood at this time what is degrading the compression.

High-Z

The High Z project successfully completed its planned experiments for FY08 at the Omega laser facility. These experiments investigated the effect on fusion yield of adding He to ICF implosions. The experiment used the standard glass shell targets we have used in the past and varied the concentration of ^{3}He in the target and measure the resulting yield. These were done for 3 different concentrations of ^{3}He, 0%, 10%, and 50% by atomic fraction. The gas fills were also designed to be hydrodynamically equivalent in order to try to insure similar hydrodynamic behavior. In addition, we also planned to measure the change in yield for two different laser pulse lengths. We first used our standard pulse length of 1.0 ns and then did a second series of experiments using a shorter pulse length of 0.6 ns. The shorter pulse length should emphasize the differences in the compression component of the yield where we believe the ^{3}He is causing a significant impact.

On April 23, we successfully fired 8 shots at Omega with 1 ns laser pulses and varied the concentration of He in the capsules. The neutron yield results from these experiments are shown in Figure 5, along with the expected degradation due to having less deuterium in the target. One can see in the figure that the observed yield does fall below the expected yield as the He is increased. We also see little difference in the ion temperature for these shots, which varies from 6.9 keV to 7.4 keV and increases only slightly as the He concentration is increased.

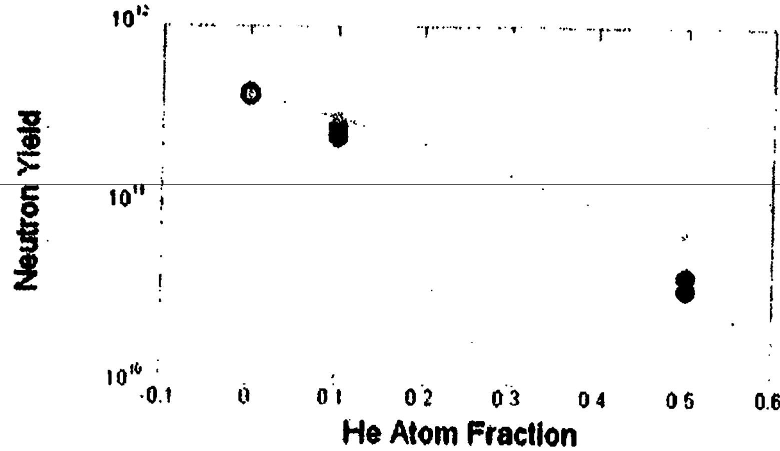

Figure 5: Neutron yield as a function of He atom fraction in the gas. The green circles are data for 1 ns pulse drive with 4.3 micron thick walls and the orange curve represents the expected yield based on the deuterium concentration only.

We also did two other shots this day with glass shells that had a thickness of 4.0 microns. These targets contained 50% atom fraction of He, but one was ^{4}He instead of the usual ^{3}He. The yields for these two shots were 4.8e10 and 4.3e10 respectively, a difference of 10%, which is similar to our standard shot to shot variation. The ion temperature for these shots was higher, ~ 8.2 keV, consistent with thinner glass and a more rapid implosion.

The remaining shots had to be done on a separate half-day June 17. We were able to get 4 shots and the results from those shots are shown in Figure 6. The behavior is similar to what we observed for the 1 ns drive shots with one exception. The ion temperatures for these experiments varied greatly, from 5.3 keV for no He to 7.8 keV for 50% He and bring into question whether the implosions are hydrodynamically equivalent. This would be consistent with an even greater

degradation of the compression burn, reducing its importance compared to the shock burn and effectively elevating the average burn temperature.

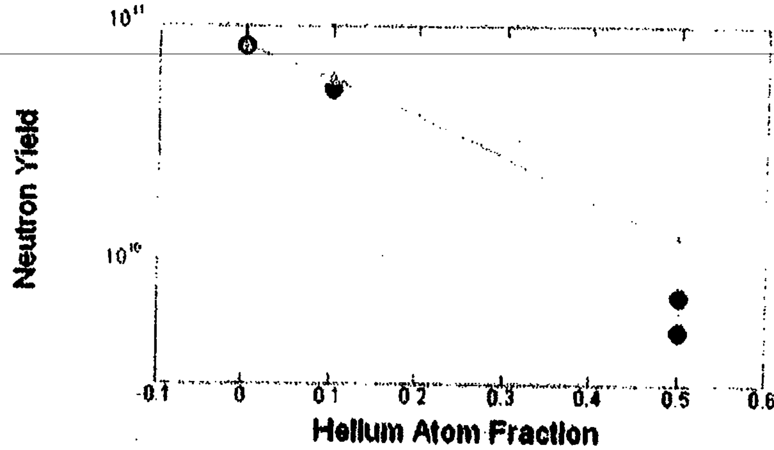

Figure 6: Neutron yield as a function of helium atom fraction in the gas. These experiments used 0.6 ns laser drive and the data is shown as the green dots. The orange curve represents the expected yield based on the deuterium concentration.

Overall, the results for doping the gas with ^{3}He were consistent with earlier results for Ar, Kr, and Xe, though a much larger atom fraction of ^{3}He was required to produce a similar effect.

NIF Platform #5

The NIF Platform #5 campaign continued experiments to develop diagnostic techniques for future NIF experiments. The FY08 experiments focused on backlighter source

characterization and development as well as the successful execution of a new platform for the observation of absorption features due to heated materials.

One aspect of the backlighters that was examined was the conversion efficiency for L-shell and M-shell emitters. Over the course of the FY08 campaign, the laser irradiance studied varied from 10^{14} W/cm^2 up to nearly 10^{17} W/cm^2. The data obtained will assist in evaluating the expected photon fluxes at the NIF. An example of some of the data obtained from a CsI backlighter is shown in Figure 7.

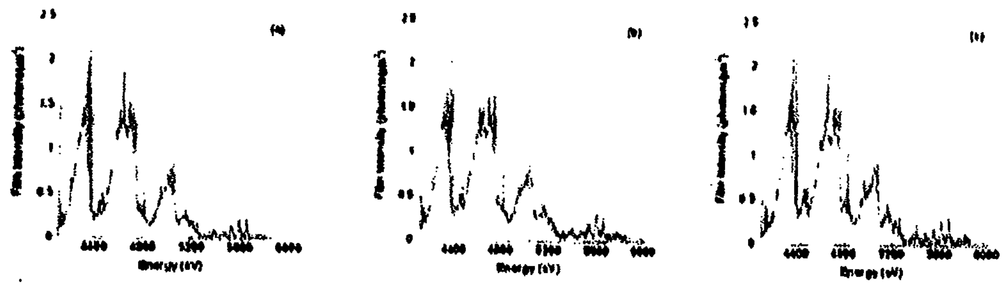

Figure 7: a) CsI spectra for a nominal 600, b) nominal 400 c) and a nominal 200(right) micron diameter spot. Note that although the laser irradiance spans an order of magnitude, the amount of emission stays essentially constant.

The platform for studying absorption spectroscopy is shown in Figure 8. A Ti foil was heated inside of a hohlraum. A CsI backlighter provided a quasi-continuum spectrum source, which passed through the sample and was recorded on by a spectrometer (Figure 9). The recorded spectrum contains both the emission from the CsI backlighter and the absorption from the heated Ti foil. Although detailed analysis is still underway, these experiments provided valuable information on the absorption spectroscopy technique and have led to a number of improvements being implemented for the future NIF experiments.

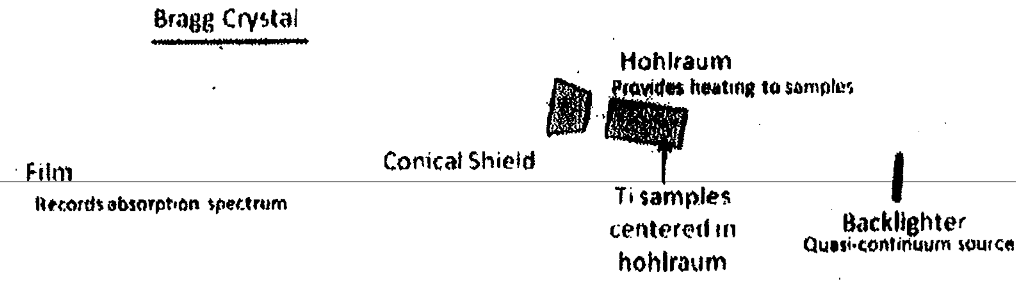

Figure 8: Picture depicting the absorption spectroscopy configuration. Laser beams enter both sides of the hohlraum. A thin Ti foil sitting in the center of the hohlraum is the heated. The backlighter provides a quasi-continuum backlighter source and its x-rays pass through the Ti sample and are reflected off the Bragg crystal and recorded on film. Some of the backlighter emission is absorbed, depending on the temperature and density of the Ti. The picture is not to scale.

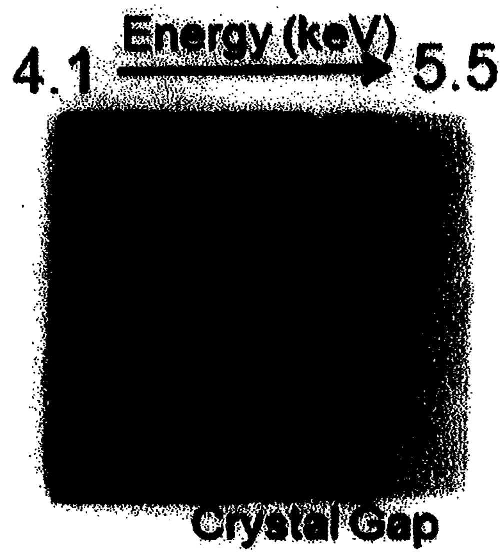

Figure 9: Spectrum containing the emission from a CsI backlighter and the absorption due to a thin, heated Ti foil.

Symergy

We have used two cones of the OMEGA laser to irradiate a linear 0.7 NIF-scale hohlraum to implode Be and CH capsules to measure the effect of beam phasing on the implosion symmetry. The vacuum hohlraums, with 2mm diameter capsules, reached 105 eV using 1 ns laser pulses. The symmetry of the x-ray emission from the implosion was measured for both the CH and Be capsules. We were able to vary the symmetry at implosion time by varying the cone fraction or ratio of energy between the inner cones [21 degrees or 42 degrees] and the outer cone [59 degree beams]. We found that the fraction where the best symmetry occurred was closest to those ratios that the re-emit technique had found for the same pointing. When we replaced the 42 degree beams by the 21 degree beams and pointed to the same location in the hohlraum with the same laser irradiance, the hohlraum radiation was lower, and the symmetry was affected, indicating some impaired propagation of the inner cone.

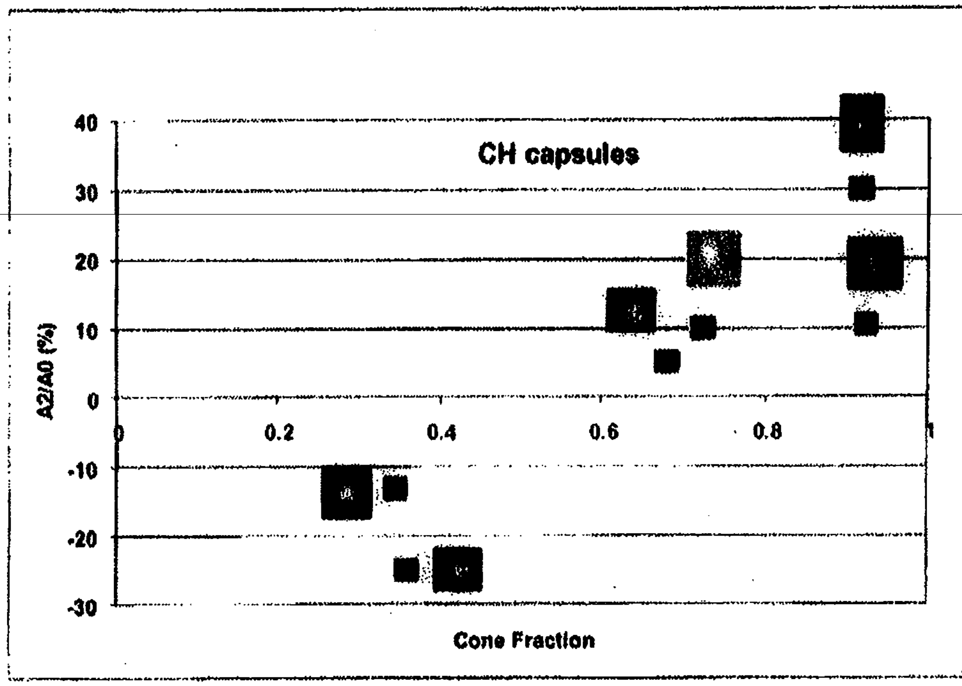

Figure 10: The measured second order Legendre coefficient for the x-ray emission at the 30% level, measured at peak emission

Aug. 27, 2008

University of Rochester Laboratory for Laser Energetics to Resume Operations

After a rigorous, three-week safety review, the Laboratory for Laser Energetics will return to operations this week.

Laboratory Director Robert McCrory initiated a voluntary "safety stand down" on Aug. 7 after an employee of the laboratory was seriously injured when a mounting bracket for a piece of diagnostic equipment broke loose while he was standing beneath it.

During the stand down, the lab's approximately 300 employees spent more than 35,000 staff hours inspecting equipment and reviewing safety procedures throughout the laboratory.

"We have carefully reviewed the safety of our equipment and procedures throughout the laboratory," McCrory said. "We have every confidence moving forward that we have eliminated to the degree possible the risk of a similar accident occurring again."

McCrory said that the recommendation to University of Rochester President Joel Seligman to resume operations was made after the equipment in question was removed from service and it was determined through the safety reviews that no other equipment in use at the laboratory poses a risk of a failure of this type. The recommendation was supported by Jeffrey Williams, a former Acting Associate Director for Engineering at Lawrence Livermore National Laboratory and an expert in laboratory accident analysis who independently reviewed the safety stand down procedures and analysis. The University's Office of Environmental Health & Safety also separately audited the review and inspections and fully supports the laboratory's return to operations.

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Anomalous yield reduction in direct-drive deuterium/tritium implosions due to ^{3}He addition[a)]

H. W. Herrmann,[1,b)] J. R. Langenbrunner,[1] J. M. Mack,[1] J. H. Cooley,[1] D. C. Wilson,[1] S. C. Evans,[1] T. J. Sedillo,[1] G. A. Kyrala,[1] S. E. Caldwell,[1] C. S. Young,[1] A. Nobile,[1] J. Wermer,[1] S. Paglieri,[1] A. M. McEvoy,[1] Y. Kim,[1] S. H. Batha,[1] C. J. Horsfield,[2] D. Drew,[2] W. Garbett,[2] M. Rubery,[2] V. Yu. Glebov,[3] S. Roberts,[3] and J. A. Frenje[4]

[1]*Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA*
[2]*Atomic Weapons Establishment, Aldermaston RG7 4PR, United Kingdom*
[3]*Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623, USA*
[4]*Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA*

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Glass capsules were imploded in direct drive on the OMEGA laser [Boehly *et al.*, Opt. Commun. 133, 495 (1997)] to look for anomalous degradation in deuterium/tritium (DT) yield and changes in reaction history with ^{3}He addition. Such anomalies have previously been reported for D/^{3}He plasmas but had not yet been investigated for DT/^{3}He. Anomalies such as these provide fertile ground for furthering our physics understanding of inertial confinement fusion implosions and capsule performance. Anomalous degradation in the compression component of yield was observed, consistent with the "factor of 2" degradation previously reported by Massachusetts Institute of Technology (MIT) at a 50% ^{3}He atom fraction in D_2 using plastic capsules [Rygg, Phys. Plasmas 13, 052702 (2006)]. However, clean calculations (i.e., no fuel-shell mixing) predict the shock component of yield quite well, contrary to the result reported by MIT but consistent with Los Alamos National Laboratory results in D_2/^{3}He [Wilson *et al.*, J. Phys.: Conf. Ser. 112, 022015 (2008)]. X-ray imaging suggests less-than-predicted compression of capsules containing ^{3}He. Leading candidate explanations are poorly understood equation of state for gas mixtures and unanticipated particle pressure variation with increasing ^{3}He addition. *© 2009 American Institute of Physics.* [DOI: 10.1063/1.3141062]

I. INTRODUCTION

Inertial confinement fusion (ICF) implosions have been conducted at US laser facilities such as NOVA and OMEGA and soon at the nearly completed National Ignition Facility (NIF). OMEGA experiments are based predominantly on direct drive, in which laser beams impinge directly on the ICF capsule.[1] NOVA was, as NIF will be, based predominantly on indirect drive in which the laser beams impinge upon the inside of a *Hohlraum*, generating a uniform bath of x rays which indirectly illuminate the capsule. In both cases, ablation of outer capsule material results in a rocket effect which compresses the remaining capsule material inward, heating and compressing the fuel primarily through pressure times change in volume (pdV) work. Additional heating comes from the initial shock received from the laser onset.

As a result, fusion product yield can be separated into two components—shock and compression yields. If the velocity of the laser-driven shock is greater than the maximum velocity of the shell, the shock can break out of the shell, travel inward through the fusion fuel, rebound at the center of the capsule, and travel outward through the fuel again. As it does so, the fuel ionizes and heats to high ion temperatures (e.g., ~10 keV), producing fusion yield before the capsule has reached maximum compression. The fuel can then cool back down after shock heating as the capsule continues to compress to maximum density, producing additional fusion yield at higher ion density but at lower ion temperature (e.g., ~5 keV). Ideally, shock and compression yields coincide, providing a synergy that maximizes fusion yield. However, experiments in which the final shell velocity is reduced, by using thick-walled capsules or by shortening of the laser pulse duration, enables one to study the individual yield components. Such studies allow additional insights into the dynamics of capsule implosions. Discerning these components of yield necessitates the ability to measure deuterium/tritium (DT) reaction histories with high precision. This study used the gas Cherenkov detector (GCD),[2-4] developed at Los Alamos National Laboratory, which relies on the DT fusion gamma-ray output for high-bandwidth measurements (~4 GHz). Gaussian decomposition of the reaction history allows one to approximate the separate bang times (i.e., time of peak of fusion reactivity) and total yields for each yield component.

While relatively efficient in terms of laser energy coupling, direct drive can also result in a higher level of spatial nonuniformities, giving rise to hydrodynamic instabilities, such as the Rayleigh–Taylor instability. These instabilities are known to result in fuel/shell mix which acts to cool the fuel and degrade the fusion yield. Radiation hydrodynamics codes [one dimensional (1D) and two dimensional] are rou-

[a)]Paper BI 1 3, Bull. Am. Phys. Soc. 53, 19 (2008).
[b)]Invited speaker. Electronic mail: herrmann@lanl.gov.

tinely used to calculate the performance of these implosions. These codes, however, typically overpredict the neutron yield, generally by factors of 2–4. Fuel-shell mix is often invoked in order to degrade the "clean" yield calculation and match the experimentally measured values.

In the current study, ^{3}He was added to capsules containing deuterium and tritium fuels. The ^{3}He was observed to degrade the fusion yield more than predicted by 1D radhydro calculations. Yield degradation was predominantly found to occur in the compression component, with little effect on the shock yield. Increased fuel/shell mix as a result of ^{3}He addition does not provide a reasonable explanation. Instead, observations appear consistent with reduced compressibility, relative to calculations, of the capsule with ^{3}He addition. Several potential mechanisms are being explored to explain this reduced compressibility.

The paper is organized as follows: Previous work and motivations for the current study are presented in Sec. II, the experimental setup is presented in Sec. III, experimental observations are presented in Sec. IV, a discussion covering reduced compressibility and fuel/shell mixing is presented in Sec. V, and conclusions are presented in Sec. VI.

II. MOTIVATION FOR ^{3}He IN DT

The use of surrogate fuels provides a means of characterizing capsule performance without incurring the complications associated with the high fusion output of DT fuel. D_2 has been the most commonly used surrogate, but the primary interest is in DT since the first igniting capsules will surely contain pure DT. When an unexplained anomaly is discovered using a surrogate, it is not obvious whether this anomaly will also exist for DT and thus must be verified. The incorporation of ^{3}He appears to provide such an anomaly. Once understood, this anomaly could potentially lead to new physics insights and might even prompt the intentional addition of ^{3}He to DT as a diagnostic tool.

While the use of DT may complicate some diagnostic methods, it also enables the use of other valuable techniques. The high fusion output coupled with a relatively high fusion gamma-to-neutron branching ratio for the DT reaction enables the measurement of the 16.75 MeV gamma rays that are emitted in just a few of every 100 000 DT fusion reactions. The time-resolved GCD was used in these studies for measurement of quality reaction histories based on the DT gamma ray.

Previous ICF implosions have revealed the possible anomalous effect (i.e., beyond what is predicted) on fusion yield arising from mixtures of D_2 and ^{3}He. The most notable is a study led by a team of Massachusetts Institute of Technology (MIT) researchers in which a series of plastic capsules containing "hydroequivalent" mixtures of $D_2/^3$He was imploded at the OMEGA laser.[5] They discovered that the compression and shock yield components were degraded relative to predictions scaled from pure D_2, with the maximum deviation occurring at 50% ^{3}He by atom.

Hydrodynamic equivalency was satisfied in this previous study by maintaining a constant Atwood number. This is achievable since D and ^{3}He have the same value of $(1+Z)/A$, where Z is the atomic number and A the atomic mass. Mixtures can then be chosen such that the mass density and total particle density (ions+electrons) are identical. This is accomplished by exchanging three D atoms for two ^{3}He atoms. Once the fuel is fully dissociated and ionized after the first passage of the laser-driven shock, the fuel is predicted to behave as an ideal gas ($pV=nRT$). Assuming that the different fuel gas mixtures achieve the same temperature profiles upon ionization, the compression and degree of shell/fuel mix for these mixtures should be nearly identical and the fusion yield should closely follow a simple scaling based on the fuel composition ratios. However, the MIT group observed that the scaled DD neutron and $D/^3$He proton yields, normalized to pure D_2, were lower than predicted by a factor of ~2 in mixtures containing 50:50 $D/^3$He by atom. These trends were observed for both shock and compression yield components. Measurements of the areal density (ρR) suggested that gas mixtures experience less compression than purer D_2 or ^{3}He target fills do, in contradiction to the hydroequivalent design hypothesis. Less compression alone, however, was not sufficient to explain the magnitude of the yield discrepancy. In addition, no single physical mechanism has been identified to explain the observations, particularly the nonmonotonic dependence on ^{3}He fraction. Comparisons of the current effort to this study will be presented in Sec. V A.

A similar abnormal effect from ^{3}He has been identified in glass capsule implosions during the "Hi-Z" experimental campaign at OMEGA being conducted by Los Alamos National Laboratory.[6] These experiments were also designed to be hydroequivalent. In this previously reported study, properly hydroscaled burn histories without and with ^{3}He (20% by atom) agree well until the time that the rebounding shock strikes the incoming shell, after which there is a divergence with less scaled yield coming from the capsule containing ^{3}He. Since the majority of shock yield occurs during the earlier period, the MIT conclusion that shock yield is anomalously affected by ^{3}He fraction is not supported. Degradation of compression yield, however, appears to be consistent with that observed by the MIT group. Implosions devised to be hydrodynamically equivalent are all expected to exhibit the same radius versus time independent of ^{3}He fraction. Contrary to this expectation, differences in shell radius with and without ^{3}He were observed from gated x-ray images during Hi-Z experiments. Shell x-ray emission suddenly brightens when the rebounding shock strikes the incoming shell. At this time, the x-ray image radii for the case with and without ^{3}He are in agreement and are consistent with simulation. After this time, however, the case with ^{3}He diverges, resulting in an ~25% larger radius at bang time than the case without ^{3}He and from the simulations with and without ^{3}He.

III. EXPERIMENTAL SETUP

Spherical SiO_x shells were fabricated by General Atomics using the glow discharge plasma method. The capsules had a mean diameter of 1098 ± 5 μm and a 4.7 ± 0.05 μm average wall thickness. All capsules were filled with 5.1 atm of 50:50 DT gas at room temperature. Residual gases, pre-

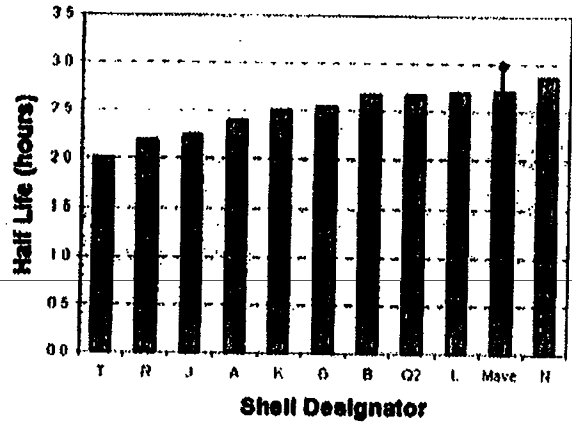

FIG. 1. (Color online) ^{3}He permeation half-lives for each individual SiO_2 shell used on shot day. Error bars on shell *M* show reproducibility of measurement.

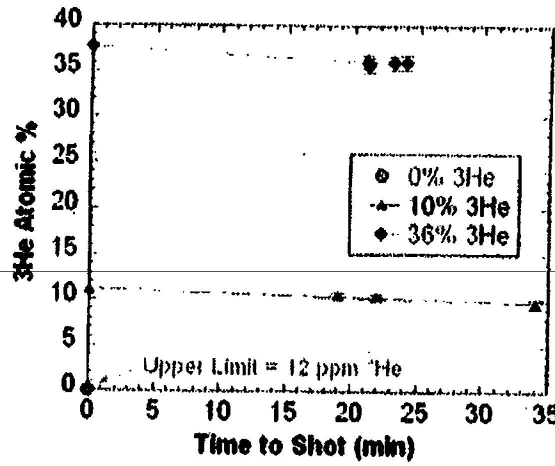

FIG. 2. (Color online) Estimated ^{3}He concentration at shot time based on individual leak rates of Fig. 1. Capsules contained ~5 atm of DT at shot time. Capsules were stored for several days in cells pressurized with ^{3}He to either 0, 1.26, or 6.05 atm, resulting in ^{3}He atomic concentrations at shot time averaging 0%, 10%, or 36%, respectively. Data points on the y axis represent the ^{3}He concentration just before depressurization of the gas cell and are for illustrative purposes only.

dominantly CO_2 and CO, were estimated to be <0.13 atm. ^{3}He was added after the DT fill, increasing the overall pressure. Three ^{3}He partial pressures were chosen, producing capsules that were not hydrodynamically equivalent to one another, and thus shot-to-calculation comparisons were required for analysis. Future experiments will strive to obtain hydroequivalency, making analysis of shot-to-shot comparisons more direct.

Accurate knowledge of the ^{3}He partial pressure in the capsule at shot time is critical for measuring ^{3}He effects on ICF implosions. Helium, being a small atom, naturally has a much higher permeation rate than hydrogenic molecules such as D_2, DT, and T_2. Typical room-temperature permeation half-lives for DT through thin glass shells are on the order of 10 weeks, whereas the half-life for ^{3}He is only a few hours. To minimize uncertainty, ^{3}He permeation rates for each individual capsule were measured by a pressure increase method[7] after the shells had already been filled with 5.1 atm of 50:50 DT gas. The results, shown in Fig. 1, indicate a mean ^{3}He permeation half-life of 2.5 h. All permeation rates were within ± 0.5 h of this mean. Capsules were stored in individual ^{3}He-pressurized containers to prevent leakage.

Shells were kept on dry ice to minimize leakage of DT. Exceptions to this include short periods at room temperature to: conduct the ^{3}He permeation tests; mount and place them in the ^{3}He-pressurized cells; and prepare them for target chamber insertion on shot day. Time at room temperature was carefully recorded to produce an accurate estimate of DT partial pressure at shot time. The time between taking a target from a ^{3}He-pressurized cell and shot time was also recorded. To minimize ^{3}He leakage and the uncertainty in the ^{3}He partial pressure at shot time, this delay was kept as short as practical. Figure 2 shows the estimated ^{3}He concentration as a function of the time to shot for the three separate fill pressures. The delay between taking a target out of a ^{3}He-pressurized cell and shot time was limited to less than 35 min for all shots, with all but one shot occurring within 25 min. As a result, uncertainty in the ^{3}He concentration was better than ±3%. It is estimated that the targets that were not intentionally filled with ^{3}He had no more than 12 ppm ^{3}He resulting from equilibrium between continuous source (tritium decay) and loss terms (permeation).

Direct-drive implosions of these targets were conducted at OMEGA using 60 beams of frequency-tripled (351 nm) UV light in a 0.6 ns square pulse and a total energy of 16.3 kJ with no smoothing by spectral dispersion. This relatively short laser pulse (as compared to the more typical 1 ns pulse used in the other previously cited studies) was chosen to reduce and delay the compression component of the yield so that the shock component would be more discernible in neutron and gamma-based reaction history measurements. As-shot conditions are summarized in Table I.

IV. EXPERIMENTAL OBSERVATIONS

The addition of ^{3}He decreases the neutron yield as shown in Fig. 3. The yield was measured by the neutron time-of-flight detector (nTOF) installed at 12.4 m from the target.[8] Shot-to-shot reproducibility was better than ±10% about the mean. DT fusion neutron yield drops by 80% between 0% and 36% ^{3}He by atom. Also plotted is the independently determined DT fusion gamma yield as measured by the GCD which shows the same trend in neutron yield as a function of ^{3}He concentration. A DT gamma-to-neutron branching ratio of 2×10^{-5} can be inferred from these data; however, uncertainty in the GCD absolute calibration is no better than a factor of 3 at this time. Recent values for the DT branching ratio vary from 5×10^{-5} to 1.2×10^{-4} gammas per neutron.[9-12] However, the measurements described in the literature are based on beam-target experiments with ion beam energies in excess of 100 keV and so may not be appropriate for thermonuclear fusion at ion temperatures ~5 keV. A 1D

TABLE I. As-shot conditions. Shell inner diameter and wall thickness refer to dimensions of the SiO_2 microballoon target. DT and ^{3}He pressures in the target at shot time are estimated from initial fill pressures corrected for DT and ^{3}He leakages based on time at room temperature and time outside of the ^{3}He-pressurized cell until shot time. Ion temperature (T_i) and neutron yield are determined using the nTOF instrument located at 12.4 m from the target chamber center. YOC is based on measured yields divided by predicted yields calculated assuming no fuel-shell mix (i.e., a clean calculation) in a 1D rad-hydro model.

Shot No.	Shell inner diameter (μm)	Shell wall thickness (μm)	DT pressure at shot time (atm)	^{3}He pressure at shot time (atm)	Total pressure at shot time (atm)	^{3}He fraction (at. %)	Laser energy (kJ)	nToF T_i (keV)	nToF n yield ($1\times10^{12}n$)	YOC
47875	1097	4.60	5.00	0.00	5.00	0.0	16	4.81	8.8	0.37
47877	1094	4.70	5.00	0.00	5.00	0.0	16.3	5.06	9.11	0.38
47881	1097	4.70	4.99	0.00	4.99	0.0	16.5	5.3	8.69	0.37
47879	1097	4.70	4.97	1.07	6.04	9.7	16.3	4.69	5.12	0.41
47873	1112	4.70	4.87	1.14	6.01	10.4	16.3	4.83	4.77	0.38
47876	1100	4.60	4.93	1.16	6.09	10.5	16	4.64	4.19	0.33
47880	1098	4.60	4.97	5.51	10.48	35.7	16.4	4.94	1.69	0.39
47874	1098	4.70	4.94	5.53	10.47	35.9	16.4	4.55	1.7	0.40
47878	1093	4.60	4.96	5.57	10.53	35.9	16.4	5.15	1.5	0.35
47882	1096	4.60	4.95	5.58	10.52	36.0	16.3	4.87	1.43	0.33
0% ^{3}He ave.	1096.0	4.67	5.00	0.00	5.00	0.0	16.27	5.06	8.87	0.37
10% ^{3}He ave.	1103.0	4.67	4.92	1.12	6.05	10.2	16.20	4.72	4.69	0.37
36% ^{3}He ave.	1096.3	4.63	4.95	5.55	10.50	35.9	16.38	4.88	1.58	0.37
Overall ave.	1098.2	4.65	4.96				16.3	4.9	4.7	0.37

radiation hydrodynamic simulation, assuming no mixing between the shell material and fuel during compression (i.e., clean calculation), shows that the measured yield is ~0.37 of calculated for all ^{3}He concentrations. This is reflected in the value of yield-over-clean (YOC) in Table I. This constant scale factor may be somewhat coincidental, however, as will be discussed in Sec. V.

Fusion reaction histories based on DT gammas measured using the GCD and DT neutrons measured using the neutron temporal diagnostic (NTD)[14] are shown in Fig. 4. Since the relative time base of the GCD instrument is not absolutely calibrated, it is cross calibrated against the absolutely calibrated NTD by matching bang times on what was considered to be the shot with the best quality NTD data (shot 47877). The time base offset relative to an optical timing fiducial is determined from this "best case." This offset was then applied to the GCD timing, also relative to the optical timing fiducial, for the remaining shots.[14] Postprocessing to remove instrument temporal response was performed on both reaction history diagnostics. The standard NTD algorithm[15] was used to remove the 1.2 ns decay time of the NTD scintillator and additional smoothing was applied. Deconvolution is able to remove much of the GCD instrument impulse response time of approximately 135 ps full width at half maximum (FWHM), leaving a residual response of approximately 70 ps FWHM. The GCD-based reaction histories for 0% ^{3}He show

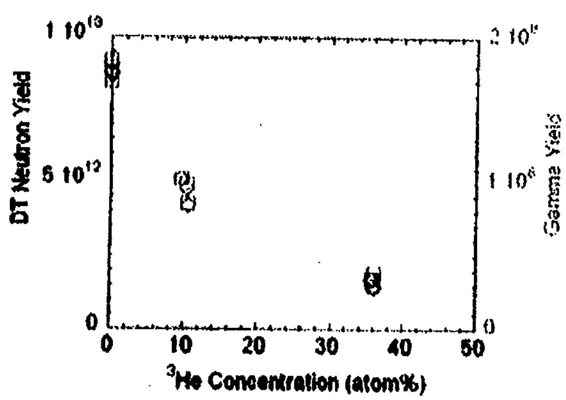

FIG. 3. (Color online) DT neutron and gamma yields as a function of ^{3}He concentration measured by nTOF (blue diamonds) and GCD (red squares), respectively. Typical absolute yield uncertainty for the nTOF is ~10%. Typical relative yield uncertainty for the GCD is also ~10%, but absolute yield uncertainty is greater due to uncertainties in GCD absolute calibration and the DT-γ/DT-n branching ratio.

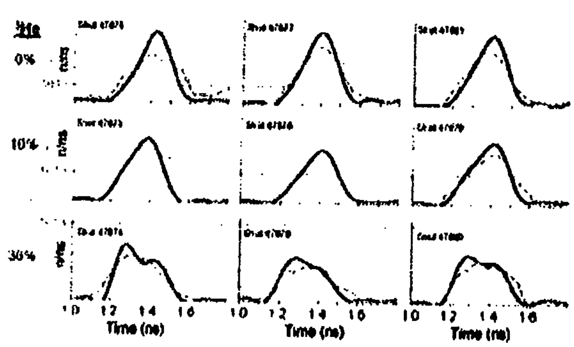

FIG. 4. (Color online) DT fusion reaction histories from the GCD (solid blue line) and the NTD (dashed pink line) show the growth of a feature near 1.25 ns as ^{3}He is added. Instrument response has been deconvolved from the data for both detectors. No NTD data were acquired on two shots (47873 and 47876). NTD data for shot 47877 were used to establish an absolute time base for the GCD data.

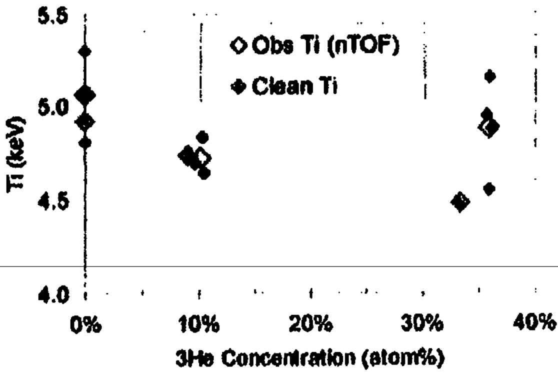

FIG. 5. (Color online) Burn averaged ion temperature measured by neutron time-of-flight (nTOF) in solid black diamonds (blue online), the mean of the measurements in open black diamonds (blue online), and a clean calculation (i.e., no shell/fuel mix) in solid gray diamonds (pink online).

an asymmetry which evolves into an observable feature on the leading edge of the GCD signal at 10% ^{3}He addition and finally becomes a discernibly separate peak at 36% ^{3}He. The NTD-based reaction histories show qualitative agreement, but due to the relatively high level of noise observed in the raw data, they were determined to be not as useful for quantitative purposes. As a result, the discussion of Sec. V relies solely on the GCD-based reaction histories.

Time-integrated ion temperature measurements using the nToF are displayed in Fig. 5. There does not appear to be a strong temperature dependence with ^{3}He concentration although calculations indicate a monotonic temperature decrease with increasing ^{3}He, whereas a slight increase was detected in going from 10% to 36% ^{3}He.

The shell radius trajectory for one shot at 36% ^{3}He addition as inferred from gated x-ray images measured using the gated x-ray imager (QXI) diagnostic[18] is shown in Fig. 6. X rays become observable once the shock wave rebounding from the center strikes the incoming shell, establishing a time reference for comparison with simulation. Also shown

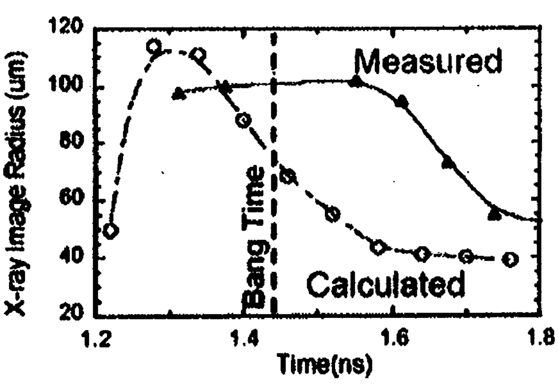

FIG. 6. (Color online) Temporal dependence of x-ray image radius for a 36% ^{3}He shot from the QXI (green diamonds) and clean calculation (open blue circles) shows less compression than expected.

are the simulated x-ray image radii based on the clean calculation. From the reaction histories, we find that the bang time for the compression component of yield occurs at about 1.44 ns. From Fig. 6 it appears that the shell radius is about 25% larger than simulated by a clean calculation at this bang time, corresponding to approximately a factor of 2 larger volume.

V. DISCUSSION

Several possible physical mechanisms pertaining to differences in composition, temperature, density, burn volume, and burn duration of the target during the implosion were explored in Ref. 5 in an attempt to explain the effect of mixtures containing ^{3}He. Some of them have the potential to explain reduced scaled yield in going from 0% ^{3}He to 50% ^{3}He, but none offers the possibility of explaining the recovery in scaled yield in going from 50% ^{3}He toward 100% ^{3}He. Although the current study has not yet explored the region from 50% to 100% ^{3}He, it is likely that this nonmonotonic behavior also exists in DT/^{3}He implosions and will be equally difficult to explain. Here we focus on the apparent symptoms of reduced compressibility and compression yield and their possible causes and then examine and attempt to discount fuel/shell mixing as a possible cause of the reduced compression yield by itself.

A. Reduced compressibility

Rather than simply investigate total yield degradation, it is more insightful to examine the shock and compression yield components individually as we explore mechanisms of yield degradation from the clean model. For this purpose, we decompose both the GCD-measured and the calculated reaction histories into two Gaussian components which are representative of the early shock yield and the later compression yield. The Gaussian decomposition for the GCD reaction histories are shown in Figs. 7(a)–7(c). These curves are a composite representing the three or four shots taken at each ^{3}He concentration. These composite GCD reaction histories are compared to the calculated reaction histories in Figs. 7(d)–7(f). It is evident that the observed compression yield degrades more quickly with increasing ^{3}He than is predicted by calculation.

The Gaussian fit parameters for the decomposed reaction histories of Fig. 7 are presented in Fig. 8. The observed (Obs) data points correspond to parameters derived from the GCD data, whereas the clean model results (Clean) are derived from the 1D rad-hydro code. In order to determine a goodness of fit for the Obs parameters, double Gaussians were convolved with the GCD instrument response function and adjusted to obtain the physically relevant optimal fit to the raw data. This allowed a sensitivity study to be conducted in which one parameter was varied while allowing the other five parameters to reoptimize the fit. It was found that the variation needed to increase the rms value of the fit by 5% was typically smaller than the shot-to-shot variation in the parameter (except when the shot-to-shot variation was exceptionally small). Thus, the parameters for the individual

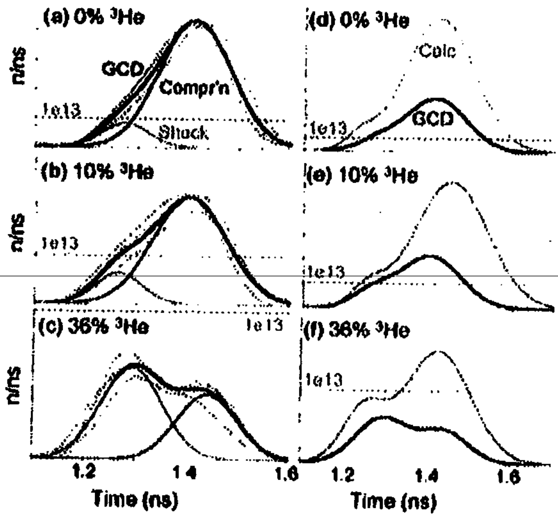

FIG. 7. (Color online) Gaussian decomposition of deconvolved reaction histories measured using the GCD instrument for (a) 0% ^{3}He, (b) 10% ^{3}He, and (c) 36% ^{3}He addition. Individual deconvolved reaction histories at each ^{3}He concentration are shown in dashed lines. Composites of the Gaussian fits to these reaction histories are shown in solid lines for the yield components arising from shock [gray (pink online)] and compression [black (blue online)], with their sum in bold black lines labeled GCD. Vertical scale is linear with the 1×10^{13} n/ns line shown in each case by a horizontal dashed line (red online) for reference. In (d)–(f) are shown the comparisons of the composites of the GCD measured reaction histories (black solid line) and calculated [dashed line (green online)]. Calculated histories are from a 1D rad-hydro "clean" calculation convolved with a 20 ps Gaussian to simulate instrument response.

shots are shown in ×'s and +'s for the Obs data set to give an indication of the amount of spread there is in data.

For the shock component of the yield, the clean calculation is reasonably consistent with the observations. These data are suggestive of a shock yield that burns at a slightly higher rate [Fig. 8(a)] for a longer period of time [Fig. 8(b)] than calculated. The resulting neutron yield [Fig. 8(d)] and bang time [Fig. 8(c)] for the shock component display reasonably good agreement between calculated and observed.

The compression yield, however, shows a considerable discrepancy between calculated and observed, with the calculated peak yield rate, FWHM, and resulting compression neutron yield being significantly higher than observed. The FWHM diverges significantly from the clean calculation as ^{3}He is increased, implying a shorter compression burn. Bang times are in reasonable agreement for compression components, as they were for the shock components.

The ratio of the observed yields to the clean calculated yields using the Gaussian fit parameters is shown in Fig. 9. The observed yield for shock is ~40% above the calculated yield on average. The shot-to-shot variation is large enough that there does not appear to be significant variation over the range of ^{3}He concentrations. The observed compression yield is 31% of calculated at 0% and 10% ^{3}He but drops to 17% of calculated yield at 36% ^{3}He. The total YOC ranges from 38% to 41% for the Gaussian fits, consistent with the ~37% YOC scaling determined Table I. The YOC remains relatively constant as the fixed shock yield makes up for the loss of compression yield with increasing ^{3}He, and thus appears to be somewhat coincidental.

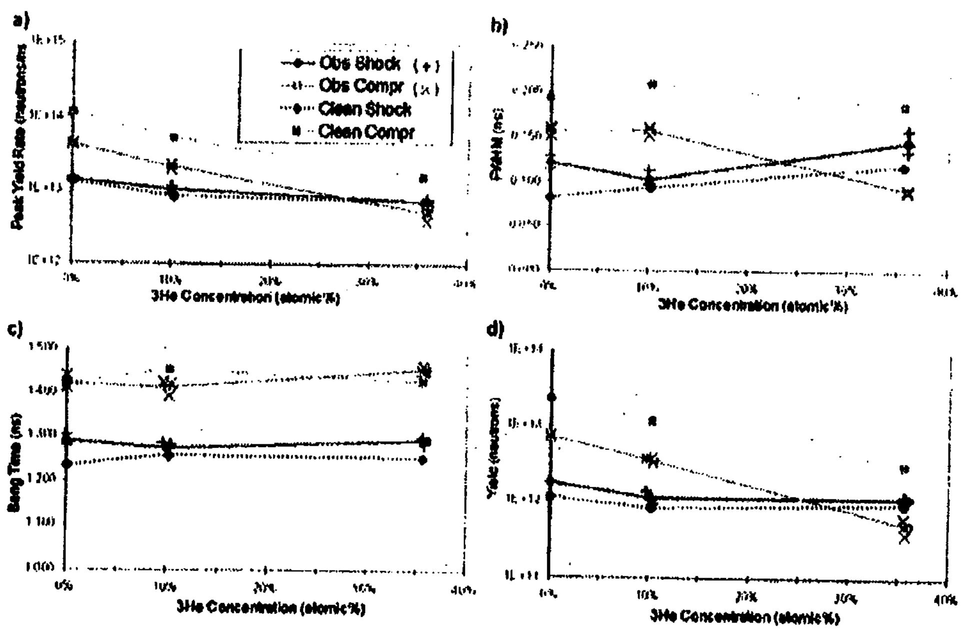

FIG. 8. (Color online) Reduction in Gaussian fits into (a) peak burn rate, (b) full width at half maximum (FWHM, semilog scale), (c) bang time, and (d) neutron yield=1.06×peak burn rate×FWHM (semilog scale). Parameters from the forward-folded fit to experimentally measured reaction histories are shown in +'s and ×'s, with their averages in open symbols/solid lines (i.e., Obs) and those from the fit to calculated reaction histories assuming no mix are shown in solid symbols/dashed lines (i.e., Clean). Shock components are in black (blue online) and compression components are in gray (pink online).

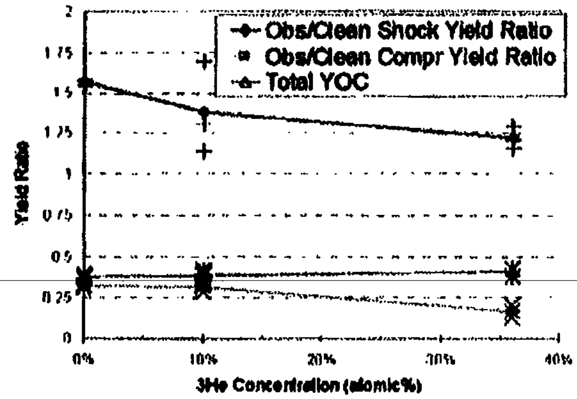

FIG. 9. (Color online) Ratio of observed to clean calculated yields from Fig. 8(d).

The observed YOC for the compression yield from Fig. 9 is replotted in Fig. 10(a) after normalizing the data to 1 at 0% ^{3}He so that a direct comparison to the MIT results can be made. It can be seen that the anomalous compression yield degradation in DT/^{3}He-filled glass capsules is consistent with that previously seen in D_2/^{3}He-filled plastic capsules.

The YOC for the shock yield from Fig. 9 is replotted in Fig. 10(b). For the shock yield we see reasonable agreement with calculation, whereas the MIT study observed a nonmonotonic trend for the 24 μm thick capsules very similar to what was observed for compression yield. For the 20 μm thick capsules, however, there does not appear to be a strong trend with ^{3}He. It should be noted, however, that the 20 μm shock yield data were considered to have too high a level of uncertainty from which to draw any conclusions, hence the lack of error bars. As previously mentioned, a Los Alamos National Laboratory study using D_2/^{3}He-filled glass capsules also observed YOC trends that were consistent with the MIT compression yield results but did not see an anomalous effect in shock yield. It should be noted that yields from different nuclear reactions are being compared in Fig. 10. The Los Alamos National Laboratory (LANL) results are for DT-γ (previously shown to be proportional to DT-n in Fig. 3), while the MIT compression yield results are determined from DD-n and the MIT shock yield results are determined from D^{3}He-p. The expectation is that these various reactions adequately represent the shock and compression yield trends with ^{3}He addition and thus enable a valid comparison.

The gated x-ray imaging measurements shown in Fig. 6 are consistent with less compression than predicted for 36% ^{3}He addition. No useful x-ray imaging data were obtained for the other ^{3}He concentrations. A 25% larger outer shell radius corresponds to approximately a factor of 2 less fusion yield, assuming a fixed shell ρR and fuel ion temperature such that the fusion yield is roughly proportional to $n_D n_T V \sim 1/r^3$. Less compression is likely to result in lower ion temperature, reducing the yield further. However, it should be noted that without a similar analysis of x-ray images for 0% and 10% ^{3}He, these arguments are not conclusive.

The nToF measurements shown in Fig. 5 are also consistent with reduced compression at 36% ^{3}He. The nToF ion temperature is a burn averaged measurement. It becomes skewed to higher temperature when the shock yield component becomes comparable to compression yield, owing to the higher ion temperatures that occur during shock yield. The ratio of compression to shock yield at 36% ^{3}He is about 3:1 in the calculation and 1:2 in the experiment, as can be seen in Fig. 8(d). Assuming that the ion temperature is 6.5 keV during shock and 4 keV during compression, the burn averaged ion temperature for 36% ^{3}He should go from ~4.4 keV in the calculation to ~5.0 in the experiment, similar to the results of Fig. 5. Thus, the unpredicted increase in T_i in going from 10% to 36% ^{3}He can be explained by the unpredicted decrease in compression yield.

The underlying assumption of previous experiments examining the effect of ^{3}He is that the capsules are truly hydrodynamically equivalent. This is based on the knowledge that the ionized gas acts as an ideal gas. However, the details of the original nonionized molecular gas will determine the shock jump conditions and thus the initial conditions for the compression of the ideal gas. Additionally, the hydroequivalency is based solely upon charged particle number density and mass density equivalency but has a discrepancy in the

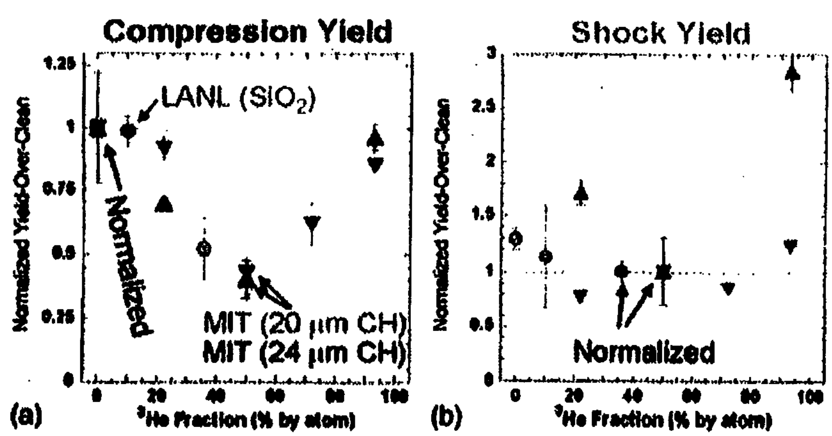

FIG. 10. (Color online) YOC for (a) compression yield component normalized at 0% ^{3}He and (b) shock yield component normalized at 50% ^{3}He for the MIT study and no normalization for the current study. In both frames, the MIT D_2/^{3}He-filled plastic capsules are shown in light blue downward pointing triangles for 20 μm thick CH capsules and dark blue upward pointing triangles for 24 μm thick CH capsules. The current study using DT/^{3}He-filled 4.7 μm thick glass capsules are shown as solid red circles. The LANL results are for DT-γ, while the MIT compression yield results in (a) are determined from DD-n and the MIT shock yield results in (b) are determined from D^{3}He-p.

individual ion and electron number densities since He contributes more electrons than D. This discrepancy leads to a change in the way energy is distributed between the ions and electrons in the fuel, and thus potentially causes a deviation from true hydroequivalency.

These arguments prompted exploration in a new direction. Perhaps differences in equation of state (EOS) between DT and mixtures containing ^{3}He may be responsible for the observed behavior. Typically, the radiation hydrodynamics codes use an EOS for deuterium and isotopically scale this EOS to tritium and ^{3}He. Cooley *et al.*[17] found that the use of a proper mixture of DT EOS and ^{3}He EOS has the effect of changing the initial conditions of the ionized fuel and as a result reducing the compressibility and compression yield with increased ^{3}He.

In addition, preheating of fuel is being questioned.[18] If ^{3}He is substantially more heated by fast electrons than DT, then a higher temperature and pressure may result in less compressibility. However, initial studies indicate that a significant amount of preheat would be required to achieve the factor of 2 reduction in scaled yield. In addition, this mechanism is unlikely to explain the nonmonotonic behavior.

B. Mix

As previously noted, the YOC for all three ^{3}He concentrations was ~0.37. An often-used method for degrading the clean yield is to apply fuel/shell mixing models.[19] It is unlikely that mix will result in less compressibility but must be examined as a possible cause of reduced compression yield since we have not conclusively demonstrated that the capsules do not compress as much as predicted at 36% ^{3}He.

Employing the Scannapieco and Cheng dynamic mix model,[20] it is found that a value of 0.065 for the mix parameter (α) is required to reduce the total yield to match the experiment with no ^{3}He. This value of α is in reasonable agreement with past experiments and fuel/shell mix may very well provide a reasonable means to explain the yield degradation at 0% ^{3}He. However, this same value of α does not explain the degradation when ^{3}He is added. It is found that a significantly larger alpha, or more mix, is needed for larger values of ^{3}He concentration. The value of α must increase to 0.09 at 10% ^{3}He and 0.15 at 36% ^{3}He. Since additional ^{3}He also means additional pressure in the capsule (more than double in going from 0% to 36% ^{3}He) and therefore increased resistance to hydrodynamic instabilities, it is expected that the required alpha would decrease with increasing ^{3}He, not increase. Such pressure stabilization has been observed previously.[19] In addition, mix is expected to produce an increasing degradation in burn rate as the mixed material propagates toward the core. This should modify the reaction history by truncating the burn is such a way that the bang time for the compression component occurs earlier and the FWHM is reduced. Although a significant reduction in compression FWHM is observed, the observed compression bang times shown in Fig. 7 agree well with calculation and are relatively independent of ^{3}He concentration.

Thus, it appears unlikely that increased fuel/shell mix with increasing ^{3}He is a viable explanation for the observed behavior.

VI. CONCLUSIONS

The anomalous degradation in measured yield previously observed in $D_2/^3$He-filled plastic and glass capsules has now been observed in DT/^{3}He-filled glass capsules in direct-drive ICF implosions. However, unlike the MIT results for $D_2/^3$He-filled plastic capsules, the anomaly appears to primarily affect the compression component of yield and not the shock component. These observations are consistent with the results of a previous Los Alamos National Laboratory study using $D_2/^3$He-filled glass capsules. The results are not consistent with increased fuel/shell mix with increasing ^{3}He. Diagnostic signatures are consistent with reduced capsule compressibility with increasing ^{3}He addition. These include lower compression yield as determined by reaction histories measured using the GCD and NTD, larger shell radius as measured by gated x-ray imaging, and larger ion temperature as measured by nToF. Several hypotheses have been advanced but not conclusively proven.

Two future experiments can provide additional information to test these hypotheses. First, hydrodynamically equivalent DT/^{3}He gas mixtures will allow better shot-to-shot comparisons with less reliance on shot-to-calculation comparison.[21] Second, ^{3}He fractions greater $\geq$50% would investigate the nonmonotonic behavior previously observed in $D_2/^3$He implosions.

ACKNOWLEDGMENTS

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[21]Preliminary hydroequivalent DT/^{3}He capsule experiments appear to be consistent with reduced capsule compressibility. These experiments will be reported separately once more data are gathered.

NIC

Gamma-Ray Physics Efforts on NIF & OMEGA
LANL P-24 Seminar
Nov 30, 2010

H.W. Herrmann
Los Alamos National Laboratory
(on Change-of-Station to NIF)

Acknowledgments

Y.H. Kim, N. Hoffman, A. McEvoy, D.C. Wilson, C.S. Young, J.M. Mack, J.R. Langenbrunner, S. Evans, T. Sedillo, S. Batha,...

Los Alamos Nat'l Lab

W. Stoeffl, L. Bernstein, P. Watts, A. Lee, J. Celeste, T. Thomas, G. Holtmeier, S. Poor, L. Dauffy, S. Azevedo, J. Liebman and the *NIF* Team

Lawrence Livermore Nat'l Lab

C.J. Horsfield, M. Rubery, W. Garbett

Atomic Weapons Establishment

E.K. Miller, R. Malone, M. Kaufman, B. Cox, Z. Ali, T. Tunnell,...

Nat'l Security Technologies

E. Grafil

CO School of Mines

V. Yu. Glebov, T. Duffy and the *OMEGA* Team

Laboratory for Laser Energetics

NIC

Outline

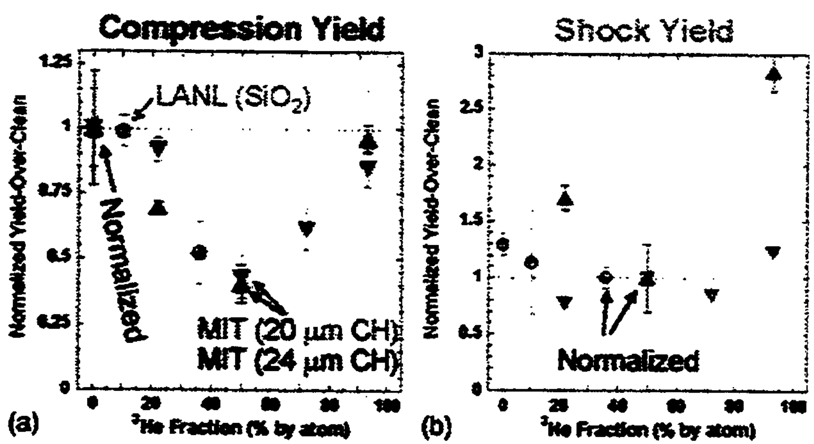
- Intro
  - Fusion Reaction History
  - γ-Ray Gas Cherenkov Detectors
- OMEGA Summary
  - Ablator areal density measurements
  - DT Fusion γ-Ray Spectrum & Branching Ratio
  - Anomalous DT yield degradation due to ^{3}He addition
- Gamma Reaction History Diagnostics (GRH) for NIF
  - GRH-6m for THD
  - GRH-15m for DT Ignition
- NIF γ-ray Measurements
  - Timing Calibrations
  - Reaction History (Bang Time & Burn Width)
- Future Directions
  - New Diagnostic Capabilities
  - Physics Studies
- Summary

Anomalies due to 3He addition to DT fuel (explored during LANL's DTRatio Campaign) might be explained by Peter Amendt's new Barodiffusion Theory

PHYSICS OF PLASMAS 16, 056312 (2009)

Anomalous yield reduction in direct-drive deuterium/tritium implosions due to ^{3}He addition[a)]

H. W. Herrmann,[1,b)] J. R. Langenbrunner,[1] J. M. Mack,[1] J. H. Cooley,[1] D. C. Wilson,[1] S. C. Evans,[1] T. J. Sedillo,[1] G. A. Kyrala,[1] S. E. Caldwell,[1] C. S. Young,[1] A. Nobile,[1] J. Wermer,[1] S. Paglieri,[1] A. M. McEvoy,[1] Y. Kim,[1] S. H. Batha,[1] C. J. Horsfield,[2] D. Drew,[2] W. Garbett,[2] M. Rubery,[2] V. Yu. Glebov,[3] S. Roberts,[3] and J. A. Frenje[4]
[1]Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA
[2]Atomic Weapons Establishment, Aldermaston RG7 4PR, United Kingdom
[3]Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623, USA
[4]Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA



PRL 105, 115005 (2010) PHYSICAL REVIEW LETTERS week ending 10 SEPTEMBER 2010

Plasma Barodiffusion in Inertial-Confinement-Fusion Implosions: Application to Observed Yield Anomalies in Thermonuclear Fuel Mixtures

Peter Amendt, O. L. Landen, and H. F. Robey
Lawrence Livermore National Laboratory, Livermore, California 94551, USA

C. K. Li and R. D. Petrasso
Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

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The observation of large, self-generated electric fields (≥10^9 V/m) in imploding capsules using proton radiography has been reported [C. K. Li et al., Phys. Rev. Lett. 100, 225001 (2008)]. A model of pressure gradient-driven diffusion in a plasma with self-generated electric fields is developed and applied to reported neutron yield deficits for equimolar D^{3}He [J. R. Rygg et al., Phys. Plasmas 13, 052702 (2006)] and (DT)^{3}He [H. W. Herrmann et al., Phys. Plasmas 16, 056312 (2009)] fuel mixtures and Ar-doped deuterium fuels [J. D. Lindl et al., Phys. Plasmas 11, 339 (2004)]. The observed anomalies are explained as a mild loss of deuterium nuclei near capsule center arising from shock-driven diffusion in the high-field limit.

- Shock-driven diffusion in the presence of large electric fields leads to ion species separation, leaving a hot spot rich in Hi-Z (e.g., 3He), poor in Lo-Z (e.g., D & T)
  - leads to reduced yield
  - may also explain reduced compressibility
- Should affect only Compression Yield; not Shock Yield
  - MIT results see effect on Shock Yield
  - LANL results do not

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Operated by Los Alamos National Security, LLC for NNSA

NNSA

Proposed experiment: XXX will determine _____

- **Purpose:**
- **Motivation:**
- **FY11 Goal:**
- **PI/Designer:**
- **Major Issues:**

Summary Shot Table	Q1FY11	Q2FY11	Q3FY11	Q4FY11
Total shots				

Experimental Configurations for [campaign]

- *This page should have a drawing (Visrad model if possible) of the experiment. Also a small summary of the laser beam requirements and diagnostics required should be included.*
- *Example shown on slide 4 – can break into multiple slides if needed*

Targets

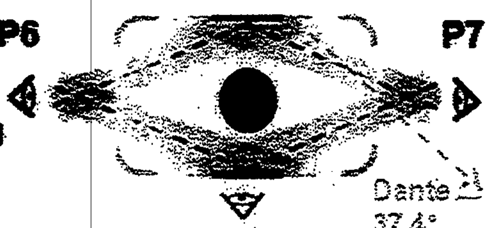
- **Include target drawing/sketch, dimensions and the "type" of target it is.**
- **Example on slide 5**
- *Type A: Developmental e.g. never been made before*
- *Type B: Complex e.g. produced before but has some schedule risk due to complex processes involved*
- *Type C: Routine/Simple e.g. hohlraums, witness plates, backlighter disks,…*

Example of experimental configuration

Experimental Config #1

P6

TIM4: LFC image LEH



P7 TIM6 : XRFC Self-emission @ >1.2 keV

Dante 37.4°

XRFC in TIMs 3,5 self-emission (=>2.2 keV)

Laser config:

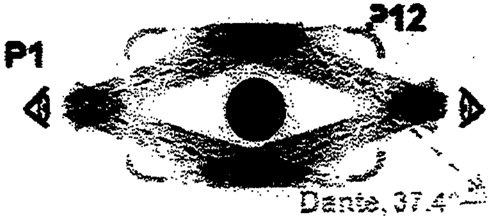
Beams	# CPPs	CPP size	Pulse	Special
20 (59°),	20	EIDI	1 ns sq	
10 (21°)	10	EIDI	1ns sq	
10 (42°)	10	EIDI	1ns sq	

[redacted]

Experimental Config #2

P1

TIM1: LFC image LEH



P12

Backscatte beam 30,25

Dante, 37.4°

XRFC in TIMs 3,5 self-emission (=>2.2 keV)

Laser config:

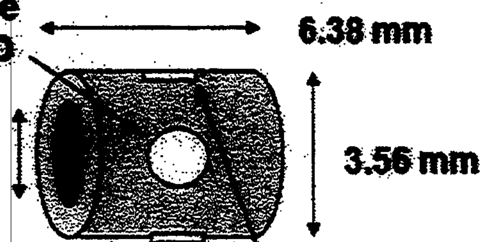
Beams	# CPPs	CPP size	Pulse	Special
20 (59°),	20	EIDI	1 ns sq	20 (59°), 10(21°)
10 (21°)	10	EIDI	1ns sq	10 (42)
10 (42°)	10	EIDI	1ns sq	

[redacted]

Example of Target Section

Target #1: Type A

Be capsule
1.4 mm OD

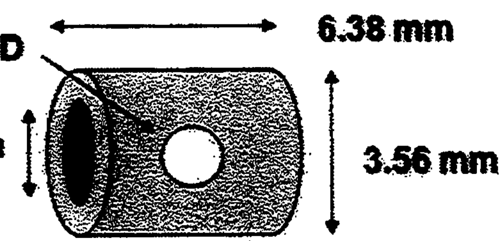


Scale 0.7 1MJ 300 eV NIF
75% LEH
Au, standard wall

Patches
(thin Be or 0.5 µm polyimide)

Target #2: Type B

CH
1.4 mm OD



Scale 0.7 1MJ 300 eV NIF
75% LEH
Au, standard wall , one patch

EXHIBIT F

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF NEW YORK

SAMUEL M. ROBERTS,

Plaintiff,

vs.

LOS ALAMOS NATIONAL SECURITY, LLC, AWE, PLC., MASSACHUSETTS INSTITUTE OF TECHNOLOGY,

Defendants,
Third-Party Plaintiffs,

vs.

UNIVERSITY OF ROCHESTER

Third-Party Defendant.

THIRD SUPPLEMENTAL RESPONSE TO PLAINTIFF'S DEMAND FOR DISCOVERY

Civil No. 11 CV 6206L

Defendant/Third-Party Plaintiff, Los Alamos National Security, LLC (hereinafter "Los Alamos"), by and through its attorneys, Woods Oviatt Gilman LLP, provides its third supplemental response to Plaintiff's First Demand for Discovery and Inspection, as follows:

PRELIMINARY STATEMENT

By responding to Plaintiff's Demand, Defendant Los Alamos does not waive any objections it may have regarding the use of information regarding the truth or accuracy of any characterizations or assumptions contained in the Demand. Defendant Los Alamos reserves its rights to make all objections identified herein or object on other grounds as to the use or admissibility of the information provided, in whole or in part, or the subject matter covered thereby, in any proceeding or trial or in any other action. Defendant Los Alamos reserves its right to object on any and all proper grounds and it, in no way, admits as to the authenticity,

competency, relevance, materiality or admissibility of any of the information provided herein. The responses of Defendant Los Alamos are, and will be, based upon information acquired thus far, and Defendant Los Alamos reserves the right to amend or supplement its responses in accordance with the Federal Rules of Civil Procedure and the Local Rules of this Court. By responding to this Demand, Defendant Los Alamos does not waive any objections it may have with regard to Plaintiff's use of the information or regarding the truth or accuracy of any characterizations or assumptions contained in Plaintiff's Demand. Defendant Los Alamos reserves its right to make all objections identified herein or object on the grounds, comment as to the use or admissibility of information provided, in whole or in part, or the subject matter covered thereby, in any proceeding or trial or any other action. Defendant Los Alamos reserves its right to object on any and all proper grounds and it in no way admits the authenticity, competency, relevance, materiality or admissibility of any of the information provided herewith.

The responses of Defendant Los Alamos are, and will be, based on the information acquired thus far, and it reserves the right to supplement its responses in accordance with the Federal Rules of Civil Procedure and the local rules of this Court.

GENERAL OBJECTIONS

1. Defendant Los Alamos objects to each request, instruction or definition to the extent that any of them seek to impose any obligation beyond that required by the Federal Rules of Civil Procedure or the Local Rules of this Court.

2. Defendant Los Alamos objects to each request to the extent it could be construed to seek information which may be covered by the attorney-client privilege, the work-product privilege, or any other applicable privilege doctrine.

3. Defendant Los Alamos objects to each request to the extent that it may be construed to seek information which is proprietary and/or confidential or otherwise restricted from disclosure to the general public.

4. Defendant Los Alamos objects to each demand that does not specify a time frame on the ground that such demands are overbroad and not reasonably calculated to lead to the discovery of admissible evidence.

5. Defendant Los Alamos objects to each demand to the extent that it purports to require the discovery of information not within its possession, custody, or control.

6. Defendant Los Alamos objects to any interpretation of each demand to the extent that it calls for information that does not refer to or relate to matters alleged in the above-captioned action.

7. Defendant Los Alamos objects each demand to the extent the Notice to Produce seeks information that is neither relevant nor reasonably calculated to lead to the discovery of admissible evidence.

9. Unless otherwise specified, all general objections apply to each numbered answer as if each general objection was specifically set forth therein.

SECOND SUPPLEMENTAL RESPONSES TO SPECIFIC DEMANDS

1. Subject to and without waiving all previously asserted objections, see materials attached as ***Exhibit A***.

The Defendant/Third-Party Plaintiff Los Alamos National Security, LLC reserves the right to amend and/or supplement its responses to these requests as may be appropriate.

Woods Oviatt Gilman LLP
700 Crossroads Building
2 State Street
Rochester, New York 14614

Dated: October 31, 2012
Rochester, New York

WOODS OVIATT GILMAN LLP

By: ______________________________
Beryl Nusbaum, Esq.
Greta K. Kolcon, Esq.
Attorneys for Defendant/Third-Party Plaintiff Los Alamos National Security LLC
700 Crossroads Building
2 State Street
Rochester, New York 14614
585.987.2800

TO: Louis J. Micca, Esq.
Attorneys for Plaintiff
11 State Street
Pittsford, New York 14534
585.899.6031

HOLLAND & KNIGHT, LLP
Christine Tramontano, Esq.
Attorneys for AWE, Plc.
31 West 52nd Street
New York, New York 10019

GEIGER AND ROTHENBERG, LLP
David Rothenberg, Esq.
Attorneys for Massachusetts Institute of Technology
45 Exchange Street, Suite 800
Rochester, New York 14614

WARD, GREENBERG, HELLER & REIDY, LLP
Eric J. Ward, Esq.
Attorneys for University of Rochester
300 State Street, 6th Floor
Rochester, New York 14614

Exhibit A

Hans W
Herrmann
5-5075
cell: 505-412-0758

OfficeMax

Steno Notebook
97333

60 Sheets • 6" x 9" • Gregg Ruled
Recycled Paper • Meets United States Government Requirements

40%

FROM 1/23/08	
TO 8/18/08	
NO. 3	

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IEC Nebel & Park 1/23/07

- 10^{-7} torr base press
- e^- emitter
  keep under vac
  need to be wired
- notebooks in JP's boxes (Glenghi)
  in lab?
  heat up slowly, start ~1V
  .1V for ~20 min
  keep < 10^{-5} torr
  eventually get to 25V
  ~ 2 days to condition emmitters
  \$8-10k for set of emmitters
  Heat Wave
  Barium impreg Tungsten
  2×10^{-6} torr for POPS operation
  $<5\times10^{-6}$

film badge for Rick.

- Emissive probe - in desk drawer ½" Aluminum
  double grid? $\approx 1\,\Omega$ top
  HV feedthru bottom & side

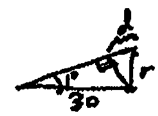
Gateway 2000 for RGA
Desktop PC w/ Labview
Vfr4cde3
shift shift 3

Bldg 482 - Schuessler
West side center 2nd Floor
Bldg 132 - Stoeffel

BT & DTRAT papers 4/23/08
** NEDPC Paper & Figs LACP
** JLIU Work Package / Capitalization
Light Pipe BW
D 3He on ZR
γ Bkgnd calcs - Duffy
* ~~IEC~~ IWD
~~** NTPD Abs 2/~~
Aug 08 DTRAT ~~glass plastic~~
NIF Diag Workshop - ~~20~~
~~PMT calcs~~
~~** NA-22 Proposal - 2/4 Mon - 1 paper~~
~~JOWOG~~
~~NIF trip rpt~~
~~** Travel~~
~~ARCEF~~
~~* NIF Project Plan 2/6~~
~~** ISO 2/~~
~~** IFSA paper deadline~~
~~Exp 9/10 ...~~
* OFES Field Work Proposal 2/5
~~* Travel Sandia~~
* 982's
* Overtarget - Thurs

Acceptance Angle

Light Pipe ~1°, 30m pipe



$r = 30 \tan 1°$

$\approx .52$ m

2" pipe

min bounces = $\frac{.52m}{.05m} \approx 10$

assume 5% atten/bounce

min atten for 1° = 42%

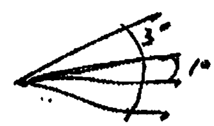
20 bounces →

solid ∠ = $4\pi r^2$

$\cos 1° = \frac{30}{30+d}$

$d = \frac{30}{\cos 1°} - 30 = 4.6$ mm

$t = \frac{d}{c} = 15$ ps



OAP Mirror

gas cell dispersion: CO_2 $n = 1.000527$ at 200nm (P?)

$V_{ch\text{-}photon} = \frac{c}{n}$ → ~~30~~ V $n = \frac{c}{V_{ch\text{-}ph}}$

$\Delta t = \frac{Ln}{c} - \frac{L}{c} = \frac{L}{c}(n-1) = 5.3 \times 10^{-4} \frac{L}{c}$

$L = 1m \rightarrow \Delta t \approx 2ps$

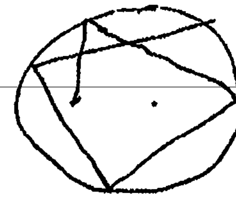
$\Delta t = \frac{x}{V_{ch}} - \frac{L}{c}$

$\geq (nx-1)/c$

Tues

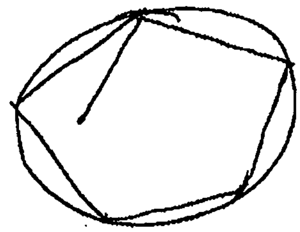
1 pm - Higdon

3-4 pm - Fortner, Bernstein



Lun

2pm Red - Blue



2-3 Moran

381 24890

2 - Higdon

11 - Duffy

Tertiaries

$E = 14.1\ \mathrm{MeV} = \frac{1}{2} m v^2 \quad v_n = \sqrt{\frac{2E}{m}} \quad V_D = 0$

$n \longrightarrow D$

$p = mv = m v_n + 2m v_D$

$$V_n = V_n' + 2V_D' = \sqrt{\frac{2E}{m}} \Rightarrow V_n' = \sqrt{\frac{2E}{m}} - 2V_D'$$

$$\frac{1}{2} m v_n'^2 + m v_D'^2 = E$$

$$\frac{1}{2} m \left(\sqrt{\frac{2E}{m}} - 2V_D'\right)^2 + m V_D'^2 = \frac{E}{m}$$

$$\frac{1}{2}\left(\frac{2E}{m} - 4\sqrt{\frac{2E}{m}}\, V_D' + 4(V_D'^2)\right) + V_D'^2 = \frac{E}{m}$$

$$3V_D'^2 - 2\sqrt{\frac{2E}{m}}\, V_D' = 0$$

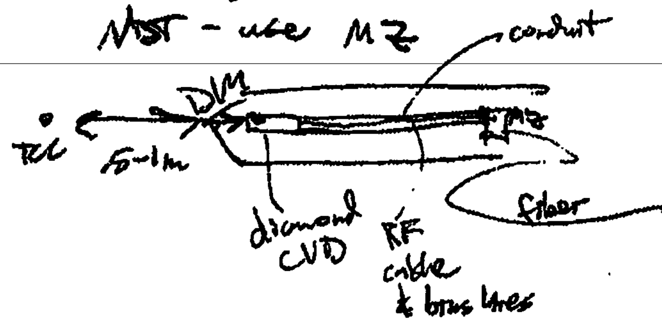
$$V_D = \frac{b}{a} = \frac{2}{3}\sqrt{\frac{2E}{m}} =$$

$$E_D = m V_D^2 = \frac{4}{9} 2E = \frac{8}{9} E = 12.5\ \mathrm{MeV}$$

GBT — LLNL   1/28/08

cable length ~130 ft

NIST - use MZ



MZ - EMP free, Optical Isolation

calibrate w/ x-rays - remove tungsten cap (~1/2")
200 ps square pulse (100 ps at Omega)

Light Pipe
10→17 m   30% reflection

4 nuclear diagnostics activation shots planned

Hi Z shadow shield for plug in front of hole
Pb? Concrete?

Get concrete scattering σ from Mike

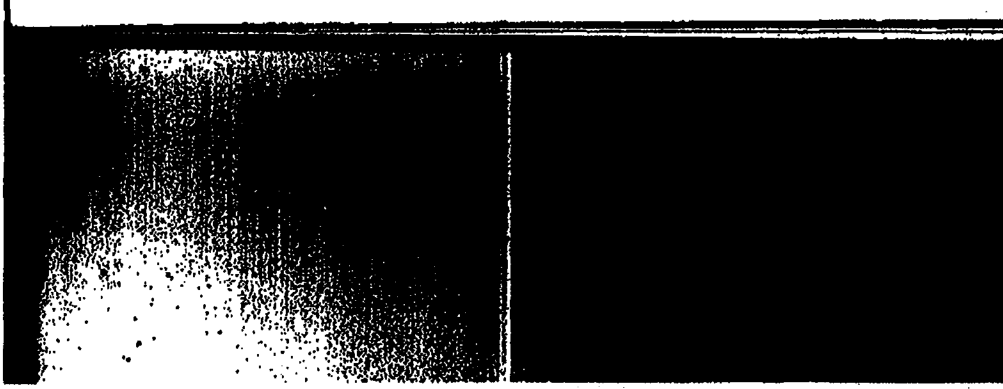
W.C. Mead n & γ scattering in NIF chamber

10keV starts attenuating at 10m air
5keV no transmission "
2.5keV atten at low He

2D to 1D fiber array
- dispersion ?

~~6pm~~ 6:30
East Ave - Italian
& Hillcrest

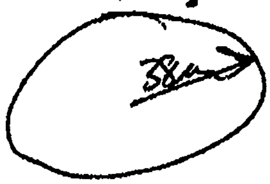
Thresh 12 MeV ~10 $\frac{ph}{e}$ 13 m geometry
100 - 22e → → 63 to mirror
6.3 MeV 50γ → 1e → 255 chph
100 → 63
#4
#4 1e → 15 chph not all detected
#5 1e → 27 "
#6 1e → 24
#11 → 34
21 36
27 2



$$\underbrace{10^{13}\,n}_{} \cdot \underbrace{10^{-5}\,\tfrac{\gamma}{n}}_{BR}\ \underbrace{\left(\frac{6\,cm}{4\pi 300\,cm}\right)^2}_{SA\ \ 5\times10^{-6}} \ \underbrace{\sim 1}_{ch\,ph/\gamma} = 500\ ch\,ph \quad \frac{10}{10\,ph} = 50\ cath\ elec$$

500 γ's

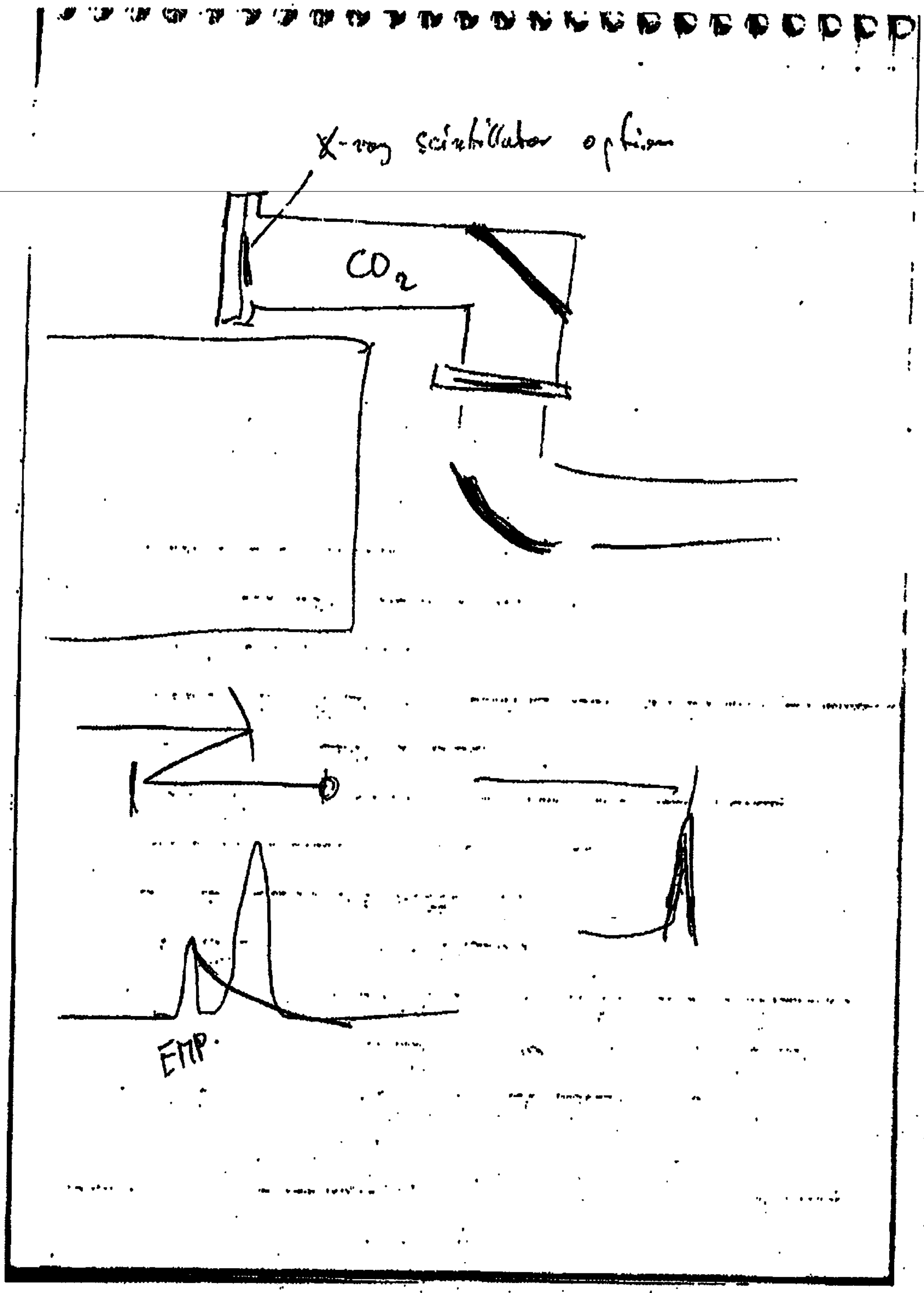
1mm → converged capsule



neutron cross sections

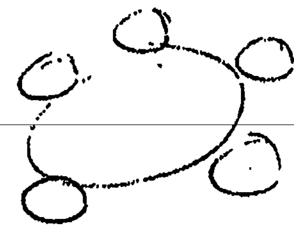
FENDL – Neutron Data Library

ENDF 7


X-ray scintillator option
CO_2
EMP

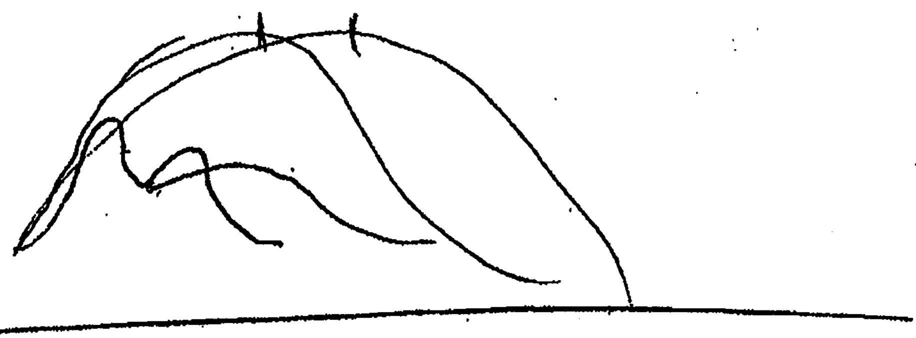
LLNL - Wolfgang 1/29/08

- port access optical table D60
  - 90° or ~~105~~°, Radiation in Switchyards
  - outside switchyards (17?° in switchyard)
- LP BW ~20m Sensitivity
- "Get lost tube" ~~for~~ ntof
- Optical design
- Streak camera, CCD rad-induced noise
- HTD target yields
- MCP to MZ to remote scopes (Diagnostic Mezzanine)
- HEXRI position?
  Riccardo Tommasini
- Compton cross section



[redacted]

accurate defined
time transfer function.



Compton Scattering (Incoherent) Be

Be: 16 MeV $\Rightarrow \sigma_c = 9.64 \times 10^{-3}\ cm^2/g$

$\rho = 1.84\ g/cm^3 \qquad d = 1.5\ cm$

$$\text{Prob} = \frac{9.64 \times 10^{-3}\ \frac{cm^2}{g}}{\cancel{1.64}} \ 1.5\ cm \ 1.84\ \frac{g}{cm^3} =$$

$= .027\ \gamma/e$

$\rightarrow 37.6\ e/\gamma$

Pb: $\sigma_c = 8.59 \times 10^{-3}\ cm^2/g, \quad \sigma_H = 4.84 \times 10^{-2}\ cm^2/g$

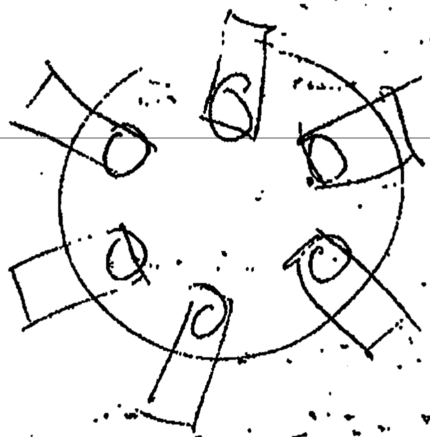
1/31/08

Kulcinski 9 students
- 300 kV
150 mA
Homer - SS 3×10^{10} n/s DT equiv
Pulsed 5×10^{9} n/s DD
$5 \times 10^{11} - 1 \times 10^{12}$ DT equiv

Wolfgang

Secondary γ's = 1/200 γ/n $\vdash$ 5 MeV
5×10^{-3}

$f_b = \frac{1}{1+ \dots}$



~ 4 %

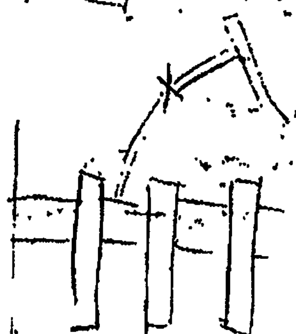
3 ...

2 cm ...

5 cm ...

.5 cm ...

1 cm ...



2 cm

γ = 67 ps

n = 400 ps

n − γ = 333 ps

$$\frac{d}{V_n} - \frac{d}{V_\gamma} = 3\,ns/d$$

$$\frac{V_\gamma - V_n}{V_n V_\gamma} = \frac{3\,ns}{d}$$

$$d = \frac{V_n V_\gamma \, 3\,ns}{V_\gamma - V_n}$$

$$= \frac{\frac{1}{6} c\, 3\,ns}{\frac{5}{6}}$$

$$= \frac{c}{5} \cdot 3\,ns = \frac{30\,cm}{5\,ns} \cdot 3\,ns$$

= 18 cm

20 cm

$t_\gamma = \frac{20\,cm}{30\,cm/ns} = .67\,ns$

$t_n = \frac{20\,cm}{5\,cm/ns} = 4\,ns$

$\Delta t = 3.33\,ns$

2/1/08

Joe
HIGS output vs. E 424-8079

Carl - $\Sigma\gamma$'s to e^- into gas for 13m, 1/8" W.
~~3 detected ch Ph / e-~~
→ 3.6 det ch P/e^- that produces a detected ch P

Turns Mtg?

Cross Sections @ 16.7 MeV

<u>W</u> Compton = 8.5×10^{-3} cm^2/g

Pair Prod = $\cancel{5.6 \times 10}$ → 4.7×10^{-3} ~~65.5×10^{-3}~~

$\rho = 19.25\ g/cm^3$

$$\text{total } \frac{e}{\gamma} = (.85 + 2 \cdot 4.7) \times 10^{-3} \frac{cm^2}{g} \cdot 19.25 \frac{g}{cm^3} \cdot \frac{1}{8} \times 254 \frac{cm}{\gamma}$$

$$= 0.63 \frac{e}{\gamma}$$

$$\text{compton } \frac{e}{\gamma} = 8.5 \times 10^{-3} \cdot 19.25 \cdot \frac{2.54}{8}$$

$$= 0.052 \frac{e}{\gamma}$$

<u>Be</u> Compton = 9.3×10^{-3} $\rho = 1.85\ cm^{-3}$

PP = 3.2×10^{-3}

$$\text{total } \frac{e}{\gamma} = (9.3 + 2 \cdot 3.2) \times 10^{-3} \cdot 1.85 \cdot 1.5$$

$$= 0.044\ e/\gamma$$

$$\text{compton } \frac{e}{\gamma} = 9.3 \times 10^{-3} \cdot 1.85 \cdot 1.5 = 0.026 \frac{e}{\gamma}$$

2/1/08

Apr ? Duke
May 19 Diagnostic Devel -
Aug 11 Dedicated Shot Day

- Simulated holdroom
- Reflective Optics
- Decoupled Streak/CCD

- Modeling
- PDR /CDR

Batra

2/1/08

$300K to USTec in May

George Sandoval, Phil Sanchez, Sam Letzring

IPO's 2/14

Colin 2/4/08

- PMT's & amp to Photek
  - 2 fast PMT's & 20k lbs.
  - GCD 2 → GCD 1 for 2 Drummond detectors. $20k lbs
- Michael Rubery - now AWE employee

VTC - 8:30 (8am in future)
011 89 85 45 26 AWE VTC
- NIF rBTR
- PMT Photek
- March Workshop
- Duke
- May & Aug Shot days

UTC 2/8/08

606-120[illegible]4

~~[illegible]~~

10:30

PMT at Febetron – Kirk

Drummond PMT

Indium O-rings for EMP sealing

Shielding [illegible]

Light Pipe

– Gold ball in May

LINAC

Vladimir – 2-TIM's, gold foil

GOD-1 drawings → Rob

– Threshold vs. Press. 125–200 psia

* target request

Sandra Z

* D^3He γ detectability

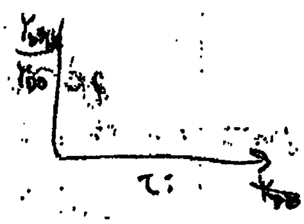
GCD Noise floor ~ 1×10^4 n/130ps in DT at 20cm

DT → D^3He variables

BR, cross section, T_i, Solid Angle

$$R \ \frac{D^3He}{DD} = \frac{\frac{1}{4} n_i^2 \langle\sigma v\rangle_{D^3He}}{\frac{1}{2} n_i^2 \langle\sigma v\rangle_{DD}} \qquad n_D = n_{^3He} = \tfrac{1}{2} n_i$$

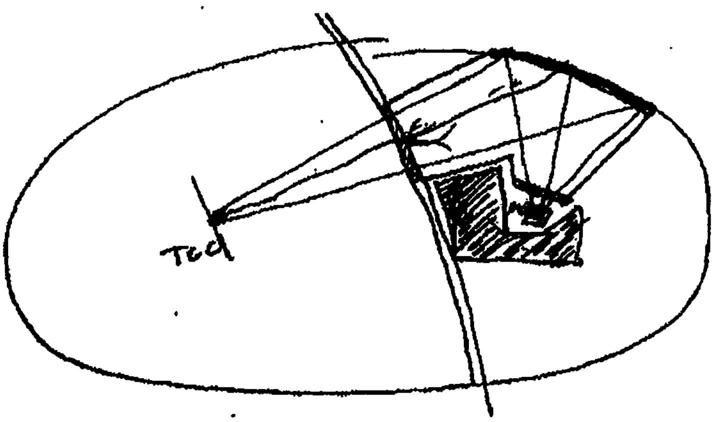
$$\sim \frac{1}{2} \frac{\langle\sigma v\rangle_{D^3He}}{\langle\sigma v\rangle_{DD}}$$



HSU – Canyon school rm 123
thurs 10am 662-4540

Duke – May 5
~~662-4540~~

GCD-1 in TIM ~~B~~
Moran's presentation → Rob

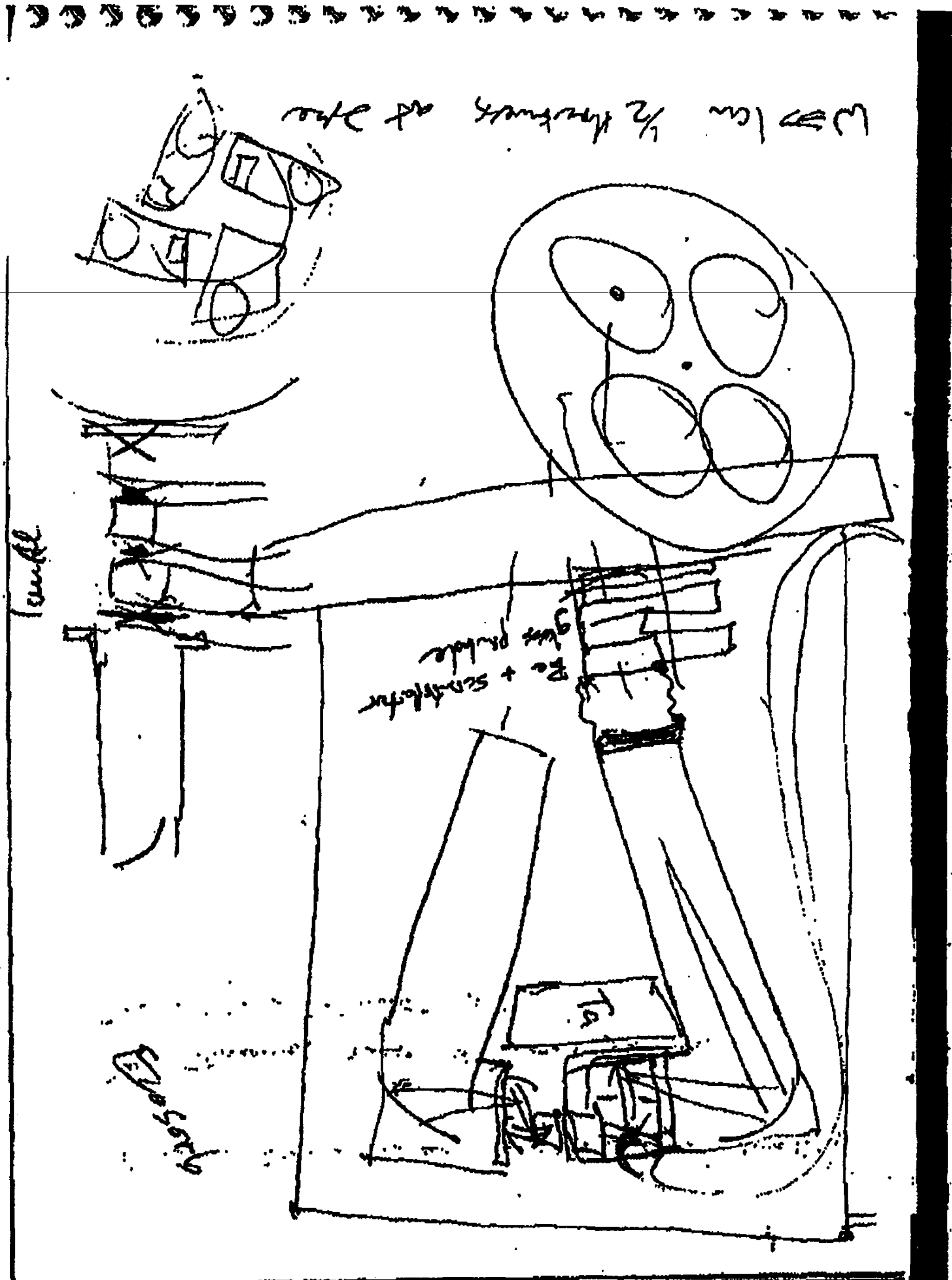


cross section database endf6
evaluated nuclear data files 24c, 60c, 62c

Gold foil
- 3 threshold energies 6.3, 8, 12
- proximity sources ?
- 2-5 cm

Converter at 5.2m, 15 cm dia?, Graphite
3 GCD's
>10 photon/e
Tungsten Shield ↓ stop Transition radiation
few mm to stop x-rays
CO_2 fluorescence? too long!

X-rays
BC422 on Be
Light - pinhole window
pneumatic actuators



[redacted]

pressurized cylinder stored energy limits

run fiducial fiber into each gas cell
run x-ray scintillator light " "

2/15/08

Mary

1) Reduced precursor in GCD-2
2) Gold foil

Colin's AUIS paperwork
- Reviewer - Cverna

Ken Hill fiber darkening at TFTR from neutrons

- Cherenkov in fiber in blue, MZ in IR → no problem
- Index of refraction change in fiber not a problem
 but is a problem in MZ
- Self calibrating
- Burst Diaz
- Triple flush to ~100 mtorr
 1/4" SS tubing
 bottle, pump, valves outside shield
 temp & press transducers to outside
- Cross w/ MCP window on one side, plumbing on other
- Al conflat (Japanese)
- Shielding calcs (Chris Hagmann)

Overtarget
3yr project starting FY10 - 12

Full Bolttoring Diag
DIM based
→ Randy

- Blast Shield - Be w/ pinhole, dimpled
face mm, ~1cm diameter

GBT/RH 5m system must cover to 1e17n
PMT/MZ at 6m on NIF
1.2m on Omega
25x less solid angle at NIF
equiv to 4e15 n at Omega

Need Shielding calcs

AWE 505-665-4165
LANL 5-2779

VTC - Colin 2/19/08

- MZ demonstrate
  * send compelling results to Colin
  - can use higher laser power!
- Is MZ essential?
  fiber darkening
  diagnostic req't ⇒ BW!
  continuity
  filter out Cherenkov in fiber
  do we need MZ in May/Aug
- Light Pipe
  meets BT req
  Single doesn't allow...
- Cassegranian
  less light collection than OAP
  need to understand precursor!
- New Scopes. TDS. 20 GHz
- EMP, rf seals on o-ring seals. 100 db.
  δ induced EMP in PMT housing
  gate out precursor? mitigate charge depletion
- May shots

PTR 2378

* Bob - send MCNP codes, papers
GCD-1 vs GCD-2 light collection efficiency

- Diagnostic envelope
1.6" point from TCC? (~4cm) ~1.3ns
can we get closer

NIF port clear aperture (52cm?)

Boost PI's Mtg - Wysocki 2/18/08

~$150k → small target fab
≤ $500k → large " (Russian experiments)
AWE $100k?

H₂ Z - Apr 23

DPR = Designated Purchasing Rep
Wortman, Kline, Flippo
Capitalization Z code 3:30

CFO 2/20/08

MIE – Major Item of Equip 14%
or Line Item
Z code – \$2M limit

Warden 2/21/08

RGD – Rad Generating Device
Rad Protection Div – ~~RGD~~ RP-1
Custodian Trng
John Elliot 5-7461 (RWP
Mont Montinez

< 40 kV

Shauna ? Div Ldr RP-1

$$v_n = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2 \cdot 14.1\times10^6\,eV \cdot 1.6\times10^{-19}\,J\,kg\,\frac{m^2}{s^2}}{1.6726\times10^{-27}\,kg}}$$

$$J = kg\,\frac{m^2}{s^2}$$

$$\frac{c}{v_n}$$

$$V_n = 5.19 \times 10^7\ m/s$$

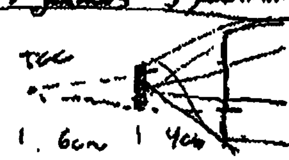
$$\frac{c}{V_n} = 5.77$$

[redacted]

- Gold Target — see [illegible] - 50μm [illegible] - [illegible] [illegible]

3×10^{13} n yield

5×10^{-5} %R



desire. $\gamma_{soc} \approx .1\,\gamma_{fus}$.

$d = 6$ cm from TCC

Solid Angle factor = $\left(\frac{10}{4}\right)^2 = 6$

≈ 1

$$\frac{\gamma_{soc}}{n} = \frac{.1\,\gamma_{fus}}{} \quad 5\times10^{-5}\frac{\gamma}{n} \cdot \frac{1}{\gamma} = 1\times10^{-6}$$

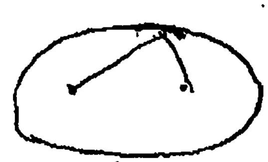
6.3 MeV threshold (100 psec)

50× less sensitive at 8 MeV than 16.5 MeV

2/25/08

$R = n_D n_T \langle\sigma v\rangle$

$$\frac{R_{0\%\,^3He}}{R_{30\%\,^3He}} = \frac{\cancel{.5}}{} = \frac{.5 \cdot .5}{.42 \cdot .5} = 11.8$$



GOD Meeting 2/26/08

- PMT under vacuum?

- Gold blast shield?
  how much gold get ablated by x-rays
  Kotorkman

- Diagnostic Schedule

- 4.5 ps/cm dispersion in glass
  over 200 to 500 nm.
  CaF has less dispersion & better UV transm
  can be used as press window
  saphire too much attenuation

- Aug prototype

2/26/08

Moran

7° across Sc slit
3° Cherenkov cone for 6 MeV
~ 8% of light
Compton ~ 3° half angle
→ ~ roughly uniform distribution to 3°
20m + ... → 30m

Omega 12m
added 6m ~ 20% eff ?

~ 2-30 mm Be – little change
lucite, graphite, polyethylene
tungsten

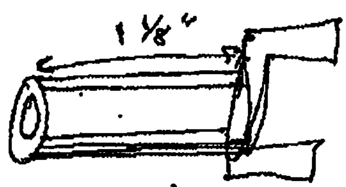
neutron Cherenkov signals – Below signal
scintillator x-ray signal

3mm W
$700K
$100k to incorporate light pipe
~$15k for second
Mike Gazer ?

Dieter

- Reviewers - Expenses
- Chuck Wilkerson
- Info - map, hotels

Gold Target holder



1 1/8" cutouts

139 ps/cm n/8 delay

$t = 1.125 \frac{2.54\,cm}{in} \; 139 \frac{ps}{cm} = 400\,ps$

Doppler Broadening to gold at 6.3 cm

$T: \approx 5\,keV$

$\delta t_{Dop} = 122 \sqrt{T}\, d$ [illegible]

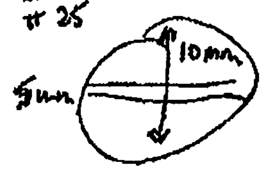
Δt in ps, d in m, T in keV

$\Delta t_{Dop} = 122 \sqrt{5}\; .063$

$= 17\,ps$

$\frac{7°}{3°} =$

$\frac{.5 \times 10}{\pi\, 25} = 6.4\%$



2/27/08

Tungsten

1cm ~~2.7cm~~ e folding

$.05 \frac{cm^2}{g} \cdot 18 \frac{g}{cm^3} \approx 1 \, cm^{-1}$

Duke

~ 5pA dark current

250 nA max current

* PMT cals - Gain & QE
2 color

TDS 7924 1GHz, 50Ω & 1MΩ

March 10 - beam parameters, dark current, rad dmg, layout, preps, triggers

May 5 - beam time, 16 hr/day for 2 days

Purchase Order ~ $32k

* Carl in P-24? * Steve ?
* Guest Sci travel exp ?

Chupp - Warden

Mono-energetic γ source

346 keV

$p + {}^{19}F \rightarrow \alpha + \cancel{\gamma} + {}^{16}O$

6.1 MeV

10^{-7} - 10^{-2} coulombs in μs

RH Meetings 3/4/08

- PMT at vacuum?
- Shielding calcs? RP-3?
- Duke PR

- DTRA QXI self emission / backlighting

- Terry Chiavone Purchasing
  664-0882

UW

5×10^9 n/s DD pulsed 4.5A, 120kV, 550μs
5-10Hz

2.2×10^8 n/s CW

Arthur Kerman
kerman@lns.mit.edu

3/4/08

✓ Gold holder to MST-?
✓ Gold parameters to HSU
~~IEC FWP~~
- NSTec PR
* IPO's
- Overtarget
- JCC
* IEC IWD
- NEDPC Paper
- ILW Work Pkg
- ~~Workshop logistics letter~~
~~OFES Rollfer~~
~~NSTEC PR~~
FDC 1772

Doug Wilson - NIF talk 3/5/08

Wilson5@llnl.gov

3/10 THD implosions - T ~ 75%
D ~ .5%, H ~ 25% (adjusts for mass)
9-3×10^14 n yield
1×10^14 TT n's

~ Pure U hohlraum .3μm Au to prevent oxidation
.3μm B-Au for SBS

Wunder

1μs = 1s exposure time
Chump → LLNL

20-40s time window for
HEU detection
delayed gammas 3-4 MeV
14 MeV n's - Ø

Santarius 3/3/08

fusion reactant energy spectra (from Doppler spread of DD-protons)
10-20 keV
5:1 CK over ionically? fusion

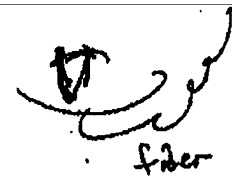
Add to proposal
✓ Santarius → ST 1.2
✓ Gian → ST 21
✓ Moses → ST 3.2 + suggestions.
✓ Bios
Figs.
Refs

MF Physics
Salerno

Steffl, Malone, Young 3/10/08

- Light on target - delay 500ns because of light scattering
  look from above or below
  narrowband filters for 2nd har, las

- Fiducial
  Comb ?
  power, wavelength ?
  preferably optical into PMT



- X-ray scintillator in GCD w/o CO_2
  fiber coupled to CO_2 GCD PMT, before neutrons

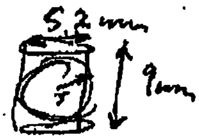
need atten to get signals at same intensity

2 MeV γ ... 1/2" e-folding in W

- PMT angular acceptance determines
  detector width

Secondary Gammas 3/12/08

Wall = 190μm Al + 50μm Au/U
= 240μm



$V_H \sim 4\pi r^2 \cdot W$ $r \simeq 3mm$ $V = 2\pi r W h + 2\pi r^2 W$

$\sim \cancel{9\ mm^3}$ $27 mm^3$ $= 2\pi(2.6\cdot 9 \cdot ... + 2.6^2 ...)$

$\boxed{V_H \simeq 40 mm^3}$ $\simeq 45.5$

Au Disk = 1cm ϕ × 2mm

$V_D = \pi\ 5^2 \cdot 2 = 157\ mm^3$

$\frac{V_D}{V_H} > 17.5$ $SA_H \simeq .8$ =

Solid Angle from TCC
$SA_D = \frac{\pi r^2}{4\pi R^2} = \frac{\pi 5^2}{4\pi\ 63^2} = 1.6 \times 10^{-3}$

$\frac{V_D}{V_H}\ \frac{SA_D}{SA_H} = .028$ $\frac{SA_H}{SA_D} \simeq 500$

Solid Angle to GCD converter

$sa_D = \frac{\pi .75^2}{4\pi\ 3.7^2} \simeq .01$

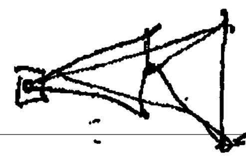
$sa_H = \frac{\pi .75^2}{4\pi\ 10^2} = .001$

$\frac{sa_D}{sa_H} = 10$

~~Signal ratio~~ $\frac{\text{Dsk gammas}}{\text{Hohlraum gammas}} \simeq \frac{sa_D}{sa_H} \cdot \frac{SA_D}{SA_H} \cdot \frac{V_D}{V_H} \simeq .28$

$LEH\ SA = \cancel{4\pi}\dfrac{2\cdot\pi\ 1.26\,mm^2}{\pi\ 4.5\,mm^2} = 15\%$

$SA_H \approx 80\%$



$V_H \approx 40\,mm^3$

$V_D \approx 157\,mm^3$

$SA_D \approx 1.6\times10^{-3}$ $\qquad Sa_D = \frac{1}{4}\left(\frac{.75}{3.7}\right)^2$ $\qquad \frac{Sa_D}{Sa_H} = \ldots$

$SA_H = .8$ $\qquad Sa_H = \frac{1}{4}\left(\frac{.75}{10}\right)^2$

$\dfrac{V_D}{V_H}\ \dfrac{SA_D}{SA_H} = \dfrac{157}{40}\ \dfrac{1.6\times10^{-3}}{.8} = 8\times10^{-3} \approx 1\%$

$\dfrac{Sa_D}{Sa_H} = \cancel{\left(\frac{3.7}{10}\right)^2} = \left(\dfrac{10}{3.7}\right)^2 = 7.3$

6 MeV γ's at 10cm from hohlraum =
$4.14\times10^{-11}\ \frac{\gamma}{cm^2}\left(\frac{600}{10}\right)^2 = 1.5\times10^{-8}$

6 MeV γ's at 10cm from Gold disc = 5×10^{-9}

$\dfrac{\text{Hohlraum}}{\text{Au Disc}} = 30$

Hohlraum $\dfrac{Au+Al}{Au} = \dfrac{360}{50} = 7$

DT Rpt

✓ AWE support, Jas
✓ Peter results
✓ Goncharov Hydro scaling

Tr at Bang Time
RT for Nym
NIS ?
GMXI vs QXI ?
Fix DT at 50:50 to set to 50% 3He
at hydro-similar
Prep new fuels
Kr ?
25% 3He to compare w/ Rygg

2117
— 76701 - Patty O'brien Bilge Office

GCD-2

Fission gamma hitting 15cm counter at [illegible]

$.35 \times 10^{-5} \frac{g}{n} \cdot \frac{[illegible]}{4\pi 10 cm^2} = 4 \times 10^{-8} \frac{g}{n\, cm^2}$

$\frac{.30\, cm}{ns} = \frac{.03\, cm}{ps}$ $\qquad \frac{2.5\, cm\; ps}{.03\, cm}$

Gaussian = $f(x) = a e^{-(x-x_0)^2/2\sigma^2}$

$FWHM = 2\sqrt{2 \ln 2}\; \sigma$

$\sigma^2 = \frac{FWHM^2}{8 \ln 2}$ $\qquad \sigma = \frac{FWHM}{\sqrt{8 \ln 2}}$

$a = \frac{1}{\sigma \sqrt{2\pi}}$

Gleason UR 3/13/08

5 NIC days 2 FY09
Oct, Dec, May, Jun, Oct 09 FY10
LANL LANL

Badge Office
1355 - Unclassified, Oracle
ID - Drivers Lic.
982 - Passport
226

Gold Target
$V_{Au} = \cancel{\pi \cdot 0.5cm^2}$
$\pi \cdot 5mm^2 \cdot 2mm = 157 mm^3$
$V_{Al}^{ring} = \pi (.25''^2 - .2''^2) .12'' = .0085 in^3$
$= 139 mm^3$

3/16/08

Photons per electron needed for given QE

$QE \approx \eta = \frac{1\,pe}{p}$ pe = photo e⁻ from photocathode

N = ave # photons / ce⁻ p = Cherenkov photons

ce = compton electron

ex: 3 e⁻, 6 P/e⁻

A B C

$4+6+3$ $4\ 3\ 2\ 1 = 10$, $3\ 2\ 1 = 6$, $2\ 1 = 3$, 1 $= 20$

pe $= 3\,e \cdot 6\,P/e \cdot \frac{1\,pe}{5\,P} = \frac{18}{5} = 3$ pe

Where do these pe come from?

prob all 3 from A, B, or C $= 3 \cdot \frac{6}{18} \cdot \frac{5}{17} \cdot \frac{4}{16} =$

=

~~18~~ ways to distribute 3 particles in 6 states

$10+6+3+1 = 20$

Odds that all 3 are in 6 of 18 states

$= \frac{6}{18} \cdot \frac{5}{17} \cdot \frac{4}{16}$

3 particles in 5 states

$= (n-p) + 2(n-p-1) + 3(n-p-2)$

1 in 5 = 5

2 in 5 = 10

4 in 5 =

5

a in p

$a = 1(a+1-p)$ 1 in 5 $1+1+1+1+1 = 5$

$(a+1-p)+(a+1-p-1)$ 2 in 5
$+(a+1-p-2)+(a+1-p-3)$

$\sum_{1}^{2} n(a-p+1) + 2(a-p) = 4+6$ $4\ 3\ 2\ 1 = 10$

3 in 5

$(a+1-p)+(a+1-p-1)+(a+1-p-2)$
$+(a-p)+(a-p-1)$
$+(a-1-p)$
$= (a+1-p)+2(a-p)+3(a-1-p) = \sum_{n=1}^{p} n(a-p+2-n)$ $3\ 2\ 1\ 2\ 1\ 1 = 10$

4 in 5 $2 = 5$

$(a-p+1)$ 5 in 5 $\cancel{a}(p-1)^2$

$a-p+1=5$ 2 in 6
$\cancel{\sum_{1}^{2}}$ $\sum_{n=p}^{a-p+p} (a-p-n+1)$ $5\ 4\ 3\ 2\ 1 = 15$
$\sum_{n=0}^{a-p} (a+1-p-n)$ 3 in 6
$a-p=3$
$a+1-p=4$

$\sum_{n=0}^{a-p} (a+1-p-n) = 4+3+2+1$ $4\ 3\ 2\ 1\ 3\ 2\ 1\ 2\ 1\ 1 = 20$
$+ \sum_{n=1}^{a-p} (a+1-p-n) = 3+2+1$
$+ \sum_{n=2}^{a-p} (a+1-p-n) = 2+1$ $\sum_{h=0}^{a-p} \sum_{m=h}^{a-p} (a+1-p-m)$

1 in 7 = 7 × 1

21 in 7

21 = 7 × 3

1 6 5 4 3 2 1 = 21

3 in 7

35 = 7 × 5

5 4 3 2 1 = 15

4 3 2 1 = 10

3 2 1 = 6

2 1 = 3

1

35

4 in 7

4 3 2 1

A = 4 3 2 1 3rd

A + 3B + 5C + 5D

10 + 18 + 15 + 5

49 = 7 × 7

C = 3

B 3 2 1 2nd

C 2 1

D = 1 1

35

C

D

B 3 2 1 1st

C 2 1

D 1

C 2 1

D 1

D 1

14 + 12 + 18 + 15 = 49

Carl 3/16/08

6×10^{14} n yield for 100 e^-

12 MeV threshold

~~[illegible]~~ 3.5×10^{-5} cp/γ

5 m, 6 cm radius, .7°

$\frac{cp}{\text{particle}} = 4.5$

$\frac{1}{4.5}$ = 22% scatters on γ

need 140 ~~[illegible]~~ quanta

BR $\approx 10^{-5}$ 100 e^-, $\times \sqrt{2}$

SA

Sens

QE

[redacted]

2 in 8

7 6 5 4 3 2 1 = 28

3 in 8

6 5 4 3 2 1
5 4 3 2 1
4 3 2 1
3 2 1
2 1
1

6 10 12 12 10 6 = 56

4 in 8

#1 3 in 7 5 4 3 2 1 = 15
4 3 2 1 = 10
3 2 1 = 6
2 1 = 3
1 = 1

$15 + 2 \cdot 10 + 3 \cdot 6 + 4 \cdot 3 + 5$
15 20 18 12 5
70

#2 3 in 6 4 3 2 1 = 10
3 2 1 6
2 1 3
1 1

3 2 1 6
2 1 3
1 1

2 1 3
1 1

5 + 12 + 18 + 20 + 15 = 70

100a gain signal S
$10^4 \rightarrow$ 80mV statistical threshold
$10^5 \rightarrow$ 800 mV

[illegible]

IRM Central
Octavio Ramos
Sheila Malony

Malone 7/17/08
Code V
Optical Research Assoc

Vargraphics -

Shandra
FV 5-1572

[illegible]

Workshop Announcements

- Egress
- Meals (Brkfst)
- Breakout handout

Moritz Kaufman
663-2034

- Fletcher Goldin NSTec Livermore
goldin.fj@nv.doe.gov
925-960-2686
Senior Scientist

[redacted]

VA-22 Proposal

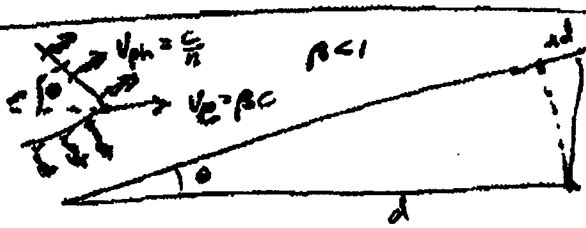
✓ Hyperlink

✓ SOW

✓ Budget - 1st Pages, Surf, Sch

✓ Delex input

Laufenbrunner



Cherenkov

$\frac{v}{c} \approx 1 - \frac{1}{2\gamma^2}$ $\beta = \frac{v}{c}$ $\sqrt{1-\epsilon} \approx 1 - \frac{1}{2}\epsilon$

$\frac{1}{2\gamma^2} = 1 - \beta$ $\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} = \frac{1}{\sqrt{1-\beta^2}}$

$\gamma^2 = \frac{1}{2(1-\beta)}$ $1-\beta^2 = \frac{1}{\gamma^2}$

$\boxed{\gamma = \frac{1}{\sqrt{2(1-\beta)}}}$ $\beta^2 = 1 - \frac{1}{\gamma^2}$

$\beta = \sqrt{1 - \frac{1}{\gamma^2}} \approx 1 - \frac{1}{2\gamma^2}$

$\cos\theta = \frac{1}{n\beta} = \frac{1}{(1+\delta)\beta}$ $\sin\theta \approx \theta$

$= \frac{1}{(1+\delta)(1 - \frac{1}{2\gamma^2})}$ $\cos^2\theta + \sin^2\theta = 1$

$\approx \frac{1}{1 + \delta - \frac{1}{2\gamma^2}} = \frac{1}{1-\epsilon}$ $\cos^2\theta = 1 - \theta^2$

$\approx 1 + \epsilon$ $\cos\theta \approx \sqrt{1-\theta^2} \approx 1 - \frac{1}{2}\theta^2$

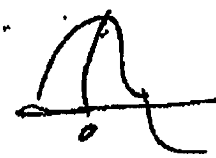
$\approx 1 + \delta + \frac{1}{2\gamma^2}$

$1 - \frac{\theta^2}{2} \approx 1 + \delta + \frac{1}{2\gamma^2}$ $\theta^2 =$

[redacted]

$\cos\theta = \frac{1}{n\beta}$ $\beta = \frac{V_{e^-}}{c}$

$= \frac{c}{nV} = \frac{V_{ph}}{V_{e^-}} \to 1$



$\cos\theta = 0°$

$\beta = \frac{v}{c} \approx 1 - \frac{1}{2\gamma^2}, \gamma \gg 1$

$\gamma \to \infty \Rightarrow \beta \to 1 \Rightarrow V_{e^-} \to c$

$\cos\theta = \frac{c}{n V_{e^-}}$

16 MeV $V_{e^-} = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2 \cdot 16\times10^{6}\,eV}{9.1\times10^{-31}\,kg} \cdot \frac{1.6\times10^{-19}\,J}{eV}} = 2.4\times10^{9}\,\frac{m}{s}$

Workman 5-1784

NIF Diagnostic Workshop 3/27/08

Hatchet - Critical Parameter

1. Shape of hot cavity & cold fuel

$1D \left\{ \begin{array}{l} \text{2. Implosion Velocity} \\ \text{3. Entropy of Cold fuel} \end{array} \right.$

4. Mix

2D/3D

- Cold fuel into hot spot
- Ablator into cold fuel

Jim Kramer requires
few 10^{12} n yield
100 dynamic range

Energy gated,

C(n,n') at 4.88 MeV

p,T reaction, 19MeV, ~100x brighter than 16.7MeV in HTD

3/28/08

Announcements
- Photo
- Visitor badges, LAUR
- Pens
-

Laptops

RH
- May GOD-2 & Au/Al - target
- Aug - DT Rad 3He, 50/50 DT?
- Sep/Dec - NIF proto

Omega Plans 3/28/08

May 08

TIM 1 or 2

2 = above

1 - preferable

Dipole Relaxation

= verify used in MCNP

NTD ~~[illegible]~~

left of TIM4

~ [illegible] TIM 1

- FTD 10000

- PMT sens. [illegible] ~~[illegible]~~

DT Pract 08 4/1/08

50:50 DT

$Y =$ DT press (atm)
$W =$ 3He press (atm)

$$Y + \frac{3}{4}W = Y_0$$

$$\%W = \frac{W}{W+Y} = \frac{W}{W + 2Y_0 - \frac{3}{2}W} = \frac{W}{2Y_0 - \frac{W}{2}}$$

$$\%W\left(2Y_0 - \frac{W}{2}\right) = W$$

$$2\%W\,Y_0 = W + \frac{\%W}{2}W$$

$$W = \frac{2\%W\,Y_0}{1 + \frac{\%W}{2}}$$

3/31/08

✓ NSTec PO 6458-REQ-08 $40k
65164-REQ-08 $2k

✓ HTPD Abs Malone LAUR

~~NA 23 Figs to Frans~~

* GBT Budget & Z-code, 1772

* IEC IWD

* ~~GBT 2-pager~~ & highlight

~~GCD papers to Wortham~~

IPO's

✓ HTPD Reg Travel

* ILIU Workpackage

~~Photobook-flat except~~

~~Gaskell / Nobile / Vargas~~

* NIF Wrkshp Talks

* LAUR-NF Wrkshp ** Duke PR

GCD-2 Mode

Au/Al target

ICC Abs

NEDPC LACP

~~Travel~~

~~LLE Travel~~

JRH Mtg - Wilson 3/16 925-423-9904

Wermer Paper

* Structural Floor

DT neutron absorption on ^3He 4/1/08

$\sigma = 5333\ b$ from Warner

$1b = 10^{-28} m^2$

$P = \cancel{10}\ atm$. $\rho = 5 \cdot \frac{3g}{mole} \frac{1 mole}{22.4 l} = 0.67\ g/l$

$\rho_0 = 0.67 \frac{g}{l} \frac{l}{1000cc} = 0.67 \frac{mg}{cc}$

Assume convergence ratio = 20

$r_0 = 1100 \mu m$. $r_f = \frac{1100}{20} = 55 \mu m$.

$\rho_f = \rho_0 \left(\frac{r_0}{r_f}\right)^3 = 0.67 \frac{mg}{cc} \left(\frac{1100}{55}\right)^3 = 5.36 \frac{g}{cc}$

$Prob = \sigma (cm^2)\ \rho \left(\frac{g}{cm^3}\right) l (cm)$

$Prob = \frac{N\sigma}{A} = \frac{\sigma \frac{4}{3}\pi r^3}{\pi r^2} = \frac{4}{3} \sigma \rho r$

$\rho_0 = 5 \frac{6 \times 10^{23}}{22.4\ l} \frac{l}{1000 cc} = 10^{20} cm^{-3}$

$Prob = \sigma \rho_f r_f = 5333 \times 10^{-32} cm^2\ \rho_0 r_0 \left(\frac{1100}{55}\right)^3 \frac{1}{20}$

$= 5 \times 10^{-27} \cdot 10^{20} \cdot \frac{0.1}{20} \left(\frac{1100}{55}\right)^3$

$= 2 \times 10^{-5}$

4/1/08

Doug Wilson

a gammas $\overset{\sim 9}{6}$-11 MeV, ~ 10^{4} γ's
~.5% in Be

C 4.44 MeV ~ 10^{-3} γ's

lead to t dep ρR measurement?

4/2/08

Mack, et al.
NSTec Livermore – PMT calibration
test facility

TIM 1 or 2

1:30 Hsu
Phil Young

[redacted]

PR, SOW

Exhibit G Security
Exhibit F Env

Joe Mack
MCNP shielding calcs. & ACCEPT
Bob Goldman has someone in mind
Jamie at Duke?

Bathon 4/8/08

✓ Z-codes
✓ JLIU workpackage ~$492K FY08 +100k +200k?
✓ P-24 FTE - Taccetti, Cobble, Dzorek, Tierney
✓ X-Div MCNP/ACCEPT FTE 40% for rest of year
* ✓ Duke PR - travel costs, Duke quote → Lori JIDF
✓ DTRA Funding
✓ NSTec PR - 40k + $300k, + $250k modules
~~* Travel + LANL~~
Joan Travel to NIF, personnel, X-1
✓ Stage I Project Plan.

RH meeting Young, Evans, Sedillo 4/8/08

Pedestal at 2cm
1cm diameter ?

~~How ma~~: n-yield to produce 100 pk e⁻
Cph/γ 1.4×10^{-3} "Age calc"
$\Omega/4\pi$ 10^{-2}

1.4×10^{-5} Cp/sγ BR $=10^{-5}$ sγ/sn
1.4×10^{-10} Cp/n. QE = .1
~~1.4×10^{-9} ... /n~~

- Ashlawn gammas to Carl

$$V_n = \left(14.1\,\text{MeV} \cdot \frac{1.6\times10^{-19}\,\text{J}}{\text{eV}} \cdot \frac{1}{1.67\times10^{-27}\,\text{kg}}\right)^{1/2} =$$

$$E = mc^2 + \frac{1}{2}mv^2$$

$$\gamma = \frac{1}{\sqrt{1-\beta^2}} = \frac{1}{\sqrt{1-.17^2}}$$

$$v = \sqrt{2\left(\frac{E-mc^2}{m}\right)} = \sqrt{2\left(\frac{E}{m}-c^2\right)}$$

$\beta = \frac{v}{c} = 17\%$

[redacted]

Capture γ's in DT fuel 4/9/08

$D(n,\gamma)T$, $\sigma \approx 10^{-5}\,b$ at ~~...~~ 14 MeV

$\rho R \simeq 0.300\ g/cm^2 \cdot \frac{6\times10^{23}}{2.5\,g} = 3.6\times10^{22}\ \#D/cm^2$

$R = n_1 n_2 \langle \sigma v \rangle \sim cm^{-3}\, cm^{-3}\, cm^2\, cm/s \sim \frac{1}{cm^3\, s}$

$R = \phi_n \sigma \rho_D$ $\quad \phi_n = \frac{n}{cm^2 \cdot s}$ $\quad \rho = \frac{\#D}{cm^3}$

$\sim \frac{n}{cm^2 s}\, cm^2\, \frac{\#D}{cm^3} \sim \frac{1}{cm^3 \cdot s}$

$r \cong \frac{1}{30}\,mm = \frac{1}{30}\,cm = 3\times10^{-3}\,cm$

$\rho_D \cong \cancel{10^{21}\,cm^{-3}}\ 10^{20}\,cm^{-3}$

$\phi_n \cong 8\ Y/\pi r^2 \cong \cancel{286\ Y}\ 3.5\times10^{4}\ Y$

$R = \cancel{286}\ 3.5\times10^{4}\ Y \frac{n}{cm^2 s}\ 10^{-5} b\ \frac{10^{-24}\,cm^2}{b}\ \frac{10^{20}}{\cancel{10^{21}}/cm^3}$

$\cong \cancel{3\times10^{-19}\ Y\ cm^{-1}\ cm^{-3}}\ 3.5\times10^{-5}\ Y\, s^{-1}\, cm^{-3}$

$V \cong \frac{4}{3}\pi\ (3\times10^{-3}\,cm)^3$

$\cong 1.1\times10^{-7}\,cm^3$

$RV = 4\times10^{-12}\ Y\, s^{-1}$ $\quad t = 10^{-10}\,s$

$RVt = 4\times10^{-22}\ Y$

[initials]

ask Butler: 4/10/08
Langenbrunner ✓

n D reactions nds.iaea.org/exfor ENDF

	σ (b)
D (n, TOT), SIG	0.81
D (n, EL) D-20, SIG	0.64
D (n, NON), SIG	0.17
* D (n, 2N) H, SIG	0.17
D (n, γ) T, SIG	9.5×10^{-6}

* Reactions: $V\!\!\cdot R = \phi \sigma \rho_0 \cdot Vt$ — $\phi t A$ = Yield

$\rho_0 T = \frac{1}{2} \rho_{at} r$

$= \sigma \cdot Y \rho_0 r$ — $\rho_{at} = .3\ g/cm^2$

$= Y \cdot 3.6 \times 10^{22} \sigma (cm^2)$ — $\rho_0 r = \frac{1}{2} \frac{.3 g}{cm^2} \frac{6 \times 10^{23}}{2.5 g} = 3.6 \times 10^{22} / cm^2$

D(n,TOT) $\xrightarrow{1b}$ $3.6 \times 10^{-2}\ Y$

D(n,γ) $\xrightarrow{10^{-5b}}$ $3.6 \times 10^{-7}\ Y$

AWE Horsfield LUFO - TT ~~FL# 06-041~~

Tully 75126
~~Paula~~ Montoya ~~Shawn Trujillo 665 6908~~

VTC: Apr 29, Jun 3, 17, 24,
Jul 1 4:30 - , 15, 22, 29
May 9 8am

[redacted]

* ILIO Wkplng / Z-code/workplan

Petrosso

✓* IEC PEA

✓* IWD

✓ May Shut Plan

* Duke PR

* LAUR's (HTPD, NIF Wkshp)

HTPD Travel

Wermer Paper

* Travel - LWC, Omega

Trng - Ann Sec Ref (6/20)

RAD Elec (5/19)

664-6947 - 2/02

Liz Allhamptyh

Amy HR

221-6395

* Form 1963, ConForce

Student Hire

Hydro-Equiv

$X = D_2$ press

~~$X = D_2$ press~~

$W = {}^3He$ press $\quad [D] = Y + 2X$

$Y = DT$ press $\quad [T] = Y + 2Z = \text{const}$

$Z = T_2$ press $\quad [{}^3He] = W$

$[D](Z+1)_D + [T](Z+1)_T + [{}^3He](Z+1)_{3He} = \text{const}$

$2(Y+2X) + 2(Y+2Z) + 3W = \text{const}$

$4X + 4Y + 4Z + 3W = \text{const}$

~~$W=0 \rightarrow 4X_0 + 4Y_0 + 4Z_0 = \text{const}$~~

~~$X_0 + Y_0 + Z_0 = \frac{\text{const}}{4}$~~

~~To ... D-rich, but $Z_0 = 0$~~

~~$X_0 + Y_0 = \text{const}$~~

~~Model~~ Model ~~...~~ $[{}^3He] = 36\%$, $[D] = [T] = 32\%$

$[{}^3He] = 36\% \Rightarrow X_1 = Z_1 = 0$, $W_1 = 5.56$

$4Y_1 + 3W_1 = \text{const}$

~~$4Y_1 + 6 + .36Y_1 = \text{const}$~~

~~$Y_1 = \frac{\text{const}}{...}$~~

$\frac{[{}^3He]}{[D]+[T]} = \frac{.36}{...}$ $\quad \frac{W}{2Y_1} = \frac{.36}{...}$

$W_1 = 5.55$, $Y_1 = 4.95$ $\quad \frac{5.55}{5.55 + 2 \cdot 4.95} = .359$

$\text{Const} = ~~...~~ 36.45$

$4X + 4Y_1 + 4Z + 3W = ~~30.46~~ 36.45 \quad X = \frac{36.45 - 4Y_1 - 3W}{4}$

$W_0 = 0$, $Z_0 = 0$, $Y = Y_0 = Y_1 = 4.95$

$4(X_0 + Y_0) = ~~30.46~~ 36.45 \quad X_0 = ~~\frac{30.46}{4} - 4.95 = 2.665~~$

~~$4X + 3W = 30.46 - 4 \cdot 4.95 = ...$~~ $X_0 = \frac{36.45}{4} - 4.95 = 4.1625$

[redacted]

[redacted]

$4x + 4Y_1 + 3W = 36.45$

$W_1 = 5.55, \quad Y = Y_1 = 4.95$

~~$4x + 3w = 30.46 - 4.4 = 16.66$~~ 16.65

$[D] = Y + 2_{10}$

$[T] = Y + 2x$

$[3He] = W$

$$\%3He = \frac{[3He]}{[D+T+3He]} = \frac{W}{2Y_1 + 2x + W}$$

$4x + 3W = 36.45 - 4Y_1$

$$x = \frac{36.45 - 4Y_1 - 3W}{4}$$

$$W = \%3He\,(2Y_1 + 2x + W)$$

$$= \frac{(2Y_1 + 2x)\%3He}{1 - \%3He} = \frac{\left(2Y_1 + 2\left(\frac{36.45 - 4Y_1 - 3W}{4}\right)\%3He\right)}{1 - \%3He}$$

$$= \frac{2Y_1 + \left(\frac{36.45}{2} - 2Y_1 - \frac{3}{2}W\right)\%3He}{1 - \%3He}$$

$$= \frac{2Y_1 + (18.225 - 2Y_1)\%3He - \frac{3\%}{2}W}{(1 - \%)}$$

$$W + \frac{3\%}{2(1-\%)}W = \frac{2Y_1 + (18.225 - 2Y_1)\%}{(1-\%)}$$

~~$4x + 3\left(\frac{Y_1 + 2x}{1 - \%3He}\right) = \frac{16.65}{10.66}$~~

~~$4x - 4x\,\%3He + 6Y_1 + 6x = 16.65$~~

~~$10x - 4\%3He\,x = 16.65 - 6Y_1$~~

~~$(16 - 4\%3He)x = 16.65 - 6Y_1$~~

~~$$x = \frac{16.65 - 6Y_1}{16 - 4\%3He}$$~~

$$W = \frac{2Y_1 + (18.225 - 2Y_1)\%}{(1-\%)\left(1 + \frac{3\%}{2(1-\%)}\right)}$$

$\% = \frac{w}{2Y_1+2x+w}$ $\quad 4x+3w = 36.45-4Y_1$

$(2Y_1+2x+w)\% = w$

$2x\% = w-(2Y_1+w)\%$

$x = \frac{w-(2Y_1+w)\%}{2\%}$

$\cancel{4}\quad \frac{2w-2(2Y_1+w)\%}{\%}+3w = 36.45-4Y_1$

$2w - 4Y_1\% - 2w\% + 3w\% = 36.45\% - 4Y_1\%$

$2w - 2w\% + 3w\% = 36.45\% - \cancel{4Y_1\%} + \cancel{4Y_1\%}$

$w = \frac{36.45\%}{2+\%}$

$x = \frac{36.45-4Y_1-3w}{4}$

4/21/08

AWE Work for Others $100k transfer

NET-3 Budget Analyst
Teresa Hampel

TT WFO Patty Montoya 75126

- Jamie
- Weller
- exaggerates

RIT Mtg 4/22/08

- ✓ NSTec Budget, Funds Xfr
- ✓ Carl's hiring
- ✓ Carl's calc's
- ✓ HiTPD - Abstracts to Bob
- ✓ NIF dimensions
- HIG SOW
- D³He gammas

- Bergren?
- ✓ Kohlmann to Carl

HIGGS prep 9/23/08.

* Pulsed PMT
* Dark Current

10 mC can result in permanent damage
- Review Invitees
Gary Hale, Damore, Cooley, Wilson, Worthen
Morgan, Nick / NSP King, Hsu

* ppt template → AARP

1 photo electron =
$1e^- \cdot 1.6\times10^{-19}\,\frac{c}{e} \cdot \frac{10^5}{10^{-10}\,s} \cdot 50\Omega$

75×10^{-4}

7.5×10^{-3} V

* Announcement

4/23/08

AET-3 DTRAT

✓ ^{3}He bottle – MST-> ?, H-Z ?

✓ Fill rig

✓ Fills

Paper

✓ Press rise → trips, equil press (12.5hrs = 5 $t_{1/2}$ ⇒ 99.5%)

✓ Egg crates – fit 3 in DT Fill Rig

need length & bore

individuals ?

Dry pump

NSTec - Tunnel 4/24/08

- Separate "Detector" & "Recording System"

FY08 $200k + ?2k
- Conceptual Design (CDR 6/24)
- Single Channel Fab & Testing

FY09
- Final Design
- Quad Fab & Testing
- Recording System
- Implementation

~~$50K~~ PR - ← 10 [illegible]
~~$150K~~ Fund Xfer. - ~~[illegible]~~ GRT & SDRD

HIGS Review   4/25/08

Reasons why Omega data does not Validate:

1. PMT cal uncertainty
2. Haven't validated γ to e^- conversion process
3. Geometry – diverging beam
   Linac was only e^- pencil beam on axis
4. BR is less than theory

RH UTC 4/29/08

GCD-1 & 2
- Vacuum checks
- LED tests

PMT cam onto TIM flange?

- characterize splitter being removed

EMP shielding of Amp

Wolfgang
- ±10" ports, ~1m FOA
Fortunes Donut Dome
- reentry tube up to 1m into chamber
~3.8m from TCC

Mon at conf
- press committee
3.5 MeV threshold will drive press

Quality 1 or 2
SDR

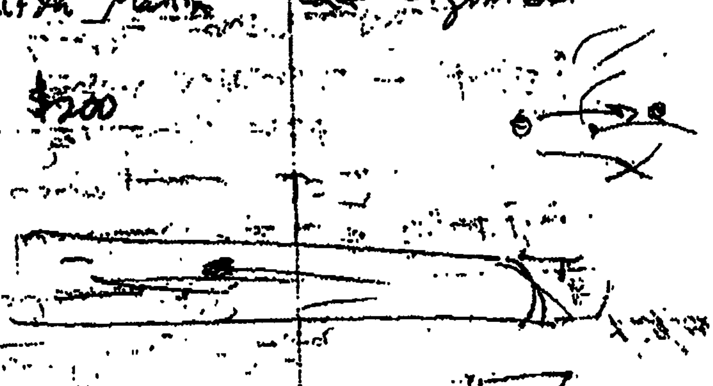
- SSC Streak Cameras – Ray Barr

Track file comparisons for Quad

	500 um	200 um
CP / Incγ	1×10^{-2}	2.3×10^{-3}
	.1	.1
CP dot / Ctrack	1×10^{-1}	2.3×10^{-2}
Malone	.06	.01 — used mm instead of cm
Young / Malone	16	2.3

HTBD GCD breakout — Hyatt Regency
Melodie Martin — Conf Organizer

$200



Project Plan - Bothe 4/29/08

- Scheduling CDR
- Wolfgang - buy in to Project Plan
- contingency 20%
- Postdoc, GRA
- Control Software - AWE?
- LLNL Contribution
- Narrative
- Split for 2 codes
- NS Tech breakdown by task FY

DTRA

[illegible] Reserve
$50k to AST

MIT contract
Klein, George

Portfolios

Work Plan
Funding Determination Board
Budget cleanup

[illegible]

HIGS 4/30/08

- PMT calibration cabilities
  Sandia Livermore?
  NSTec Livermore
- PMT relative cal vs time

- When will Colin be in Rochester? [illegible]
- P. Sanchez needed - Ortelia, at least [illegible]
- γ photonuclear activation

DTRA Target Prep 5/1/08
UTC w/ Fooks.
- manifold - 1/4 female swage to vac (we gave VCR)
- fill cell base holes
- Contamination
- Schedule

room temp at LLE ~ 30 dys
lecture bottle not compatible w/ Regulator
dry pump

$\cancel{\log f(x)^3}$

$\cancel{a\ (\log x)}$

$y = \log f(x)$

$y(x) = \log f(x)$

$y(x = x_1) = \log f(x - x_1)$

$y(x - x_1) + c_2 = c_2 + \log f(x - x_1)$

$= \log c_3 f(x - x_1)$

J. Stone 585-275-5286

5-4778

5/6/03

NSTec

CaF vs. fused Si
200 psia – 10% more thicker CaF
~ same dispersion for thicker CaF
~ 1" thick
~3ps dispersion 1" CaF
4ps 1" fused Si
over 250-800nm

Colgan
– manifest on boxes, antistat bundle
Scopes, cables, pulser, adapter
– ~~Streamlined~~ BT.

Area of spherical surface

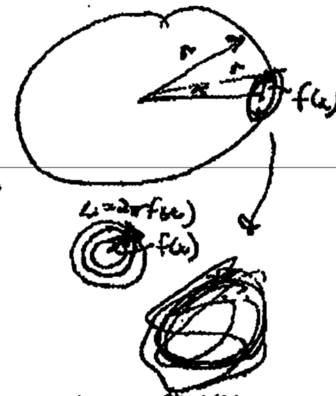
Wikipedia - Area

$f(x) = \sqrt{r^2 - x^2}$

~~A =~~ $L = 2\pi f(x)$

$W = \cancel{f(x)\,dx}\ \sqrt{1+f'(x)^2}\,dx$

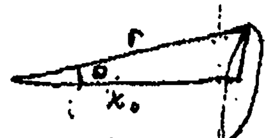
$f'(x) = \frac{-x}{\sqrt{r^2-x^2}}$



$A = \cancel{2\pi}\ L\,W = \cancel{2\pi f(x)\, f'(x)\,dx}$

$= \int_{x_0}^{r} 2\pi f(x)\sqrt{1+f'(x)^2}\,dx$

$= 2\pi r \int_{x_0}^{r} dx = 2\pi r\,(r - x_0)$



$\theta = \cos^{-1}\frac{x_0}{r}$

$x_0 = r\cos\theta$

$A = 2\pi r\,(r - r\cos\theta)$

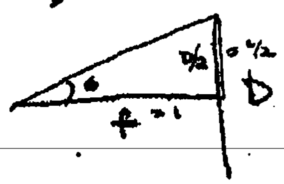
$= 2\pi r^2 (1 - \cos\theta)$

$f(\theta) = \sqrt{r^2 - r^2\cos^2\theta} = r\sqrt{1-\cos^2\theta} = r\sin\theta$

71088

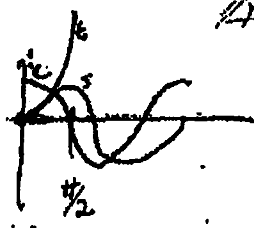
$f/\# = \cancel{\frac{\text{Aperture Dia}}{\text{focal length}}}$

$= \frac{f}{D}$



$f/\# = \frac{f}{D}$

$\phi = \tan^{-1}\left(\frac{D/2}{f}\right) = \tan^{-1}\left(\frac{1}{2f\#}\right)$



$\tan = \frac{\sin}{\cos}$

f	ϕ
0.5	45°
1	26.6°

$N = f\#$

$\phi = \tan^{-1}\left(\frac{1}{2N}\right)$

[redacted]

Reaction History Mtg. w/ LLNL & LLE 5/8/08

- Jean Steve → Wolfgang

- 200 psec window for GCD-1

Project Regency Aby - HTPD
GBT/BRAD Review 5/12/08

APS Nomination by WED

- OAP Mirrors
  - Janos
  - Sorl
- Alignment checkout
- UV collection - threshold softening w/ & w/o dispersion in XCCBT
- Omega Fiducial channel availability
- Dual rf input MZ for XRD + PMT
- Dec calibration scheme
  - fiducial
  - impulse response

* Sensitivity to Mirror position & Surface figure
- 66" = 167.6 cm to first flange surface at Omega

5/28/08

Omega Debrief

Ans.
GOD-1 in TIM 1
GOD2 in TIM2

- Isolate ground
- Monitor HV & AC
- Filter ac - UPS?
- Ask LLE about "clean" facility ac
- SRS - V vs I trips, V Monitor BW, UPS (Htrip +)
- LP PMT HUPS?

APC UPS RS800 5/29/08
supplied 91 W. for 47 min (5/29) / 36 min (5/30)
spec is 100 W for 60 min

Wolfgang
- HV hi pass filter
10 nF - 50 nF 5-10 kV penny size
- 5 W, few kΩ
- HV PS w/o volt trip, ie. Fluke

5/28/08

✓ ~~Travel~~
* NIF Diag Setup (Springer) → Wolfgang
✓ ~~Work Pkg JLLD, $60k → X-3~~
* ~~Project Plan pdf → Batha 5/30~~, 2-wk
✓ ~~SRS NV trip~~, ~~High~~ Low ~~Pass Filter~~
✓ ~~Elec Equip Appr - IEC → Yoshiko~~
~~David Aranas~~
~~Petrosso~~
~~Dave a mistake lead~~
~~* NIF workshop email~~
* Ann Sec Ref Trng (6/20)
✓* ~~Conference Form 1965~~
✓ Student Hire
* RST resubmission
~~* FY09 Omega Shot Req → Thomas~~
~~* Travel 6/15~~
~~* DTRat 08 Proposal - 6/17~~
~~* DTRat Summary JCF Update~~
✓* NSTec Contract
✓ ~~Duke PC~~
* IEC JWD.
~~Eb~~ Z

5677

HV trip solutions — P. Sanchez 6/2/08

- Ferrite Inductor in HV line
  Fast-rite 78
- fast phosphor
- MCNP input deck

JSC JWD

Mark Martinez RCT (replaced Jennifer)
Debbie Baca
Don O'Rourke

~ spot

$\frac{h'}{(h'-s)}$

6/3/08

Terry Chacon - PR
APP = Am. Funding. Thing
min $100k
Larry Raybud 52977

- Composition - ≤3% ^{3}He, DT 50/50 & same fill
- Temp. - No trend, but not to resolved
- Density ✓
- Burn Volume ✓
- Burn Duration - FWHM, BT

$Y_{DT} = \int n_D n_T \langle\sigma v\rangle_{DT}\, d^3r\, dt$ $\quad n_D = \rho V$

$Y \approx n_D n_T \langle\sigma v\rangle R^3 t$ $\quad \sim \rho R^3$

$\sim \rho^2 R^3 T^4 R^3$ $\quad nkT = P_{press}$

$T \sim \frac{P}{n}$

$Y_{DD} \approx \int \frac{1}{2} n_D^2 \langle\sigma v\rangle_{DD}\, d^3r\, dt$ $\quad \sim \frac{P}{\rho R^3}$

$\sim n^2 T^4 R^3 t$

$\rho^2 R^2 R^3 T^4 t \quad \sim (\rho R^3)^3 T^4 t$

$\frac{t}{\rho R^3} \quad \frac{C}{(\rho R)^3 R^3}$ DT

6/4/08

Debbie Brun IWD

hold point - contact FOD for D_2
put D_2 outside & use He

- hydrogen monitor
- room vol for D_2
- battery
- solder IWD - Yingho
- LN, air displacement
- Hazard Rating → Milemote, Matrix Gradfns

Cyl Size B = 8.5" D × 31" H = 17.2 l = 0.61 ft^3
C = 6" × 24" = 6.88 l = 0.24 ft^3

8' 25 12 = 2400
Hot Cell ~ 10' × 20' × 15' (H) = 3000 ft^3

Assume 3000 psi full

B: $P_2 = \frac{P_1 V_1}{V_2} = \frac{3000^{\#} \cdot 0.61 \cancel{ft^3}}{\underset{2400}{3000} \cancel{ft^3}} = 0.61$ psi

$\frac{0.61}{14.7} = 4.1\%$

C: $4.1 \cdot \frac{.24}{.61} = 1.6\%$

$V_1 = \frac{P_2 \cdot V_2}{P_1} = \frac{.04 \cdot \overset{13.2}{\cancel{14.7}} \cdot \overset{2400}{\cancel{3000}}}{3000} =$ ~~0.588 ft^3~~ 0.42

Jeremote 9417

6/3/08

DT Rat : 3He Add

✓ Summary Slide - Rygg & RH
- Hydro - Equiv not obs
✓ Rygg Shock yield
✓ BT & FWHM
- D/T Ratio results
✓ Ti

IXSRC

Werner DT gas composition
49.5% T, 48.5% D, 1.3% H, .6% He
Jan07 → 51.5 T, 47.8% D .6%

NSTec Funds Xfr
Sum Gersenger
702-295-4735

Susan at NKPCC

AFP Larry Royal (CFO) 5.2997

- Approved Funding Program 24th

Site-to-site transfer

- Cash Order ICO - Integrated Contract Order

Travel

Joy - 58401

- Authorization request
- Reg Form

6/11/08

~~AFP GCD Spreadsheet → Finance~~

Cable characterization

$\frac{\$}{10^6} / \frac{1}{\$10^{[illegible]}} = .$[illegible]

JASONS - Bill Chandler

Donovan - Cooley

VTC 6/11/08

MZ discussion - Stoeffl, Miller, Lowry, Duffy

50Ω termination in PMT?

Hama has trimmed termination built in.

S. Bathe 6/13/08

- HV trip
- Duke $
- DTRaf
- NsTec - PR, AFP, Z-codes

AFP - NSTec carryover

LANL carryover limit 13%

formalize AFP contract ? contracted quantity?

- signed contract

Capital - Wolfgang?

6/24/08

Trident

- bias voltage - filter voltage

emails
- Garbett
- CSoM student
- TT NDA w/ CEA
✓ Chacon
✓ Carl's Salary

DTRat

Ian Tregellis ?

DD-p
DT-n & D^3He-p
DT-^3He

Calcs w/ R(t), $T_i(t)$, $T_e(t)$, R(t)
nToF simulation
QX1 slm , PTD & CPS

No x-ray SC, backlighter, MMI ~~osc~~

$\tan 45° = \frac{l}{1cm}$

1cm

$l = 1cm$

l

cl -

*FABS
*Te
*QX1 filter - low E for first shock pass

APS Abstract, 7/18
Training - Exp/Cntr 21208 6/20; Foreign Host
* $\supseteq$ - 3" bore, triax
* Travel
Troubleshooting Checklist
✓ LLNL Capital
Highlight

6/24/08

NSTec

- AFP $200K [redacted] now, ≈$400k in Aug
- Reporting, Accountability
- cubes, including cal inj
- variable aperature compatibility
- cell & mirror diameters

Duke 6/25/08

- NSTec PDR 7/15
- Swap DTRatt/primo

Cooley

EOS, Laser Coupling, Atomic Physics

ICF Mix,

Stratification - Paglieri

* ^3He in shell

ZR

100 - 130 ns

$$x_0 = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$y = ax^2+bx+c = a(x-x_1)(x-x_2)$$

emails 7/8/08

~~EAS authority~~
~~Paytrust~~
~~Travel approval~~
LANL Volunteer
APS 4 Corners
REV3 Specs
Surrogate GBT, Wolf
~~Funnel~~ Ingeneering, Tele, Yoppo (TTC), distrib
Dreier - Wkshp Sur
~~Johann~~
~~Marks~~
~~PST 7/14~~
~~Gem - Swap, TMs, → Vladimir~~
Computer Accreditation
Kyrala - Fluorescent Imaging Strips
~~Gatell~~
Z
~~Bruce Taylor - L3, IS2?, modeling~~
~~510 292 6223~~
~~Wilke~~ cell 505 670 3256
Martinez - 54677
Werner - cell 412-8782
pager 78081

[redacted]

7/8/08

~~* RSI resubmission 7/14~~

NSTec Reporting & Contract

~~* TE FWA~~

~~* Incident EMP~~

~~* AWE visit~~

TT NDE w/ CEA

~~APS Abs 7/18~~

~~Terry Exp Cntrl 21208.6~~

~~Foreign list~~

Z - 3" bore - Gordon

~~Travel Aug~~

~~Troubleshooting Checklist~~

✓ LLNL Capital - Scopes

~~* QX1~~

* NIF software, Drew letter

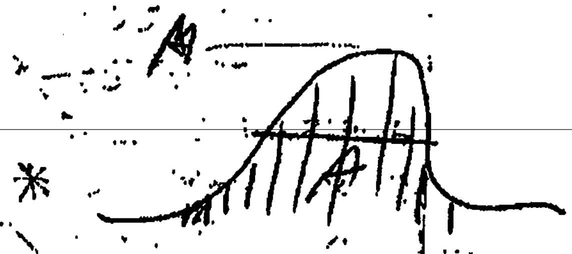
✓ ~~LLE visitors, Tim Sgk~~

* DPP Paper Talks 8/8

MIT CPS/RTD/WRF

~~* APS Abs~~

CPR 9/20



A = fwhm · M

$A = \Sigma\, y_n \cdot \Delta t = 5ps\ \Sigma\, y_n$

Data

Electrometer (current source)

Assymetry (fms)

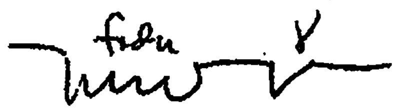
effect of Pulle beam monitors

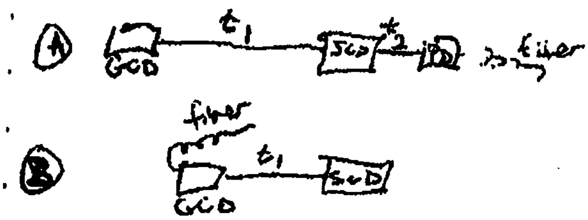
Fresnel

$T = \left(\frac{\Delta n}{\Sigma n}\right)^2$

sapphire 355nm 8% at each surface

[redacted]

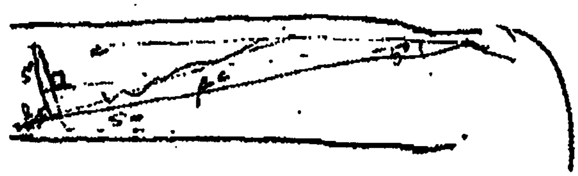




$t_\gamma = t_1$
$t_{fidu} = t_2$

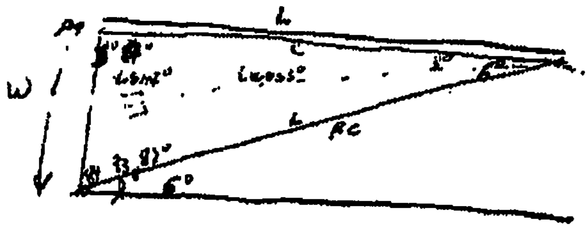
$t_\gamma = t_1$
$t_{fidu} = t_1$

$\Delta t_{fidu} = t_2 - t_1 \quad \approx - t_1$

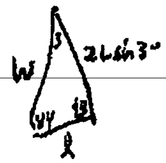


~~R_{max}~~ $=$ $\quad l =$

$KE = E - .511\ MeV =$
$E = \frac{1}{2} m v^2, \quad v = \beta c, \quad$ ~~β~~ $\beta = l/t_n$



$\frac{174}{2} = 87$



$$\frac{l}{\sin 3^\circ} = \frac{W}{\sin 93^\circ}$$

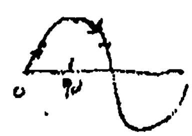
$$l = W\,\frac{\sin 3^\circ}{\sin 93^\circ}$$

$$= .052\,W$$

W = 15 cm

$$= 0.79\text{ cm}$$

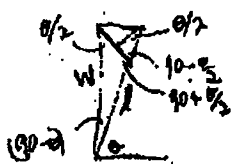
$t = \frac{l}{c} = \cancel{0.26\,ps}$ 26 ps



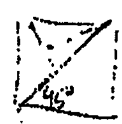
$$l = W\,\frac{\sin\theta/2}{\sin(90+\theta/2)}$$

$\theta \to 90^\circ$

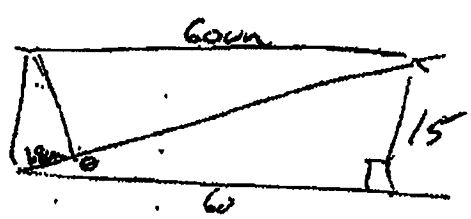
$$l \to W\,\frac{\sin 45}{\sin 135} \to W$$



$$l = W\,\frac{\sin\theta/2}{\sin(90+\frac{\theta}{2})}$$



$\frac{18\text{cm}}{3\times10^{10}\text{cm/s}} \approx 60\text{ps}$



$\tan\theta = \frac{15}{60}$

$\theta = 14°$

Jan Tragellis 7/17/08

	DT-n	DD-p	D³He-p
0	2.8e12	1.05e10	—
10	1.4	6.25e9	7.78e7
36	5.68e11	7.42e8	7.66e7

1100μm ID, 4.9μm wall
15kJ, 600ps
Te, Ti, Rt, RH

L. Abney 7/17/08

overall $188k

10% carryover $100k

project ~~$130k~~ 120 HH + 4k ~~$20~~ 16 - C4

MES $30k + 15% capital equip tax

carry ~~60~~ ~~200~~ 168

available $168k

$692 to NSTec
$220 spent
812

EAOD - ~~$40 forecast~~ & available

NSTec

6514
35366
5596

~~e-xPA~~

e- xPA

1.6e12
~~[illegible]~~ Cooley 2e12
Doug 4.3e12

10 atm D2 1.6644 e-3 g/cm3
DT 2.0785 e-3

Kim Thomas - Hsu $\boxed{982}$
7-7778
Melissa Robinson COS 7-7978

Sydor P.M.T210 available
~~[illegible]~~-804
Butler
202-586-7822
X-3 → Z code
X433

$D^3/He - \gamma$

100 γ $\frac{1.3e-3\ Gph}{\gamma}$

D^3He γ/p = $5\times10^{-5}\ \gamma/p$

$\frac{100\ \gamma/p}{5\times10^{-5}\ \gamma}$ $10^6\gamma$ $\frac{1.3\times10^{-3}\ Gph}{\gamma}$

$\frac{50\ \text{dete}\ \gamma}{10^6\ \gamma}$ = 5×10^{-5} γ det effic

$\frac{.3mm}{ns} = \frac{.3mm}{ps}$

$\frac{ps}{.3mm} = \frac{3.3ps}{mm}$

$= \frac{33ps}{cm}$

n = [illegible] $\frac{ps}{cm}$

$160\ \frac{ps}{cm}$

hihlrarm spectrum → Carl

Dry Ice – Red Diamond

$72.05 ~~$67.66~~

Brian 585-254-6844

DTRA + UTC

- SrO_x composition $x = 1.2-1.4$? impurities
  ^3He conc in shell density
- recirculator?
- cable tests

Bob Bourque - Press limits 7/23/08

ASME Boiler & Press Vessel Code
Sec 8 - Div 1 &/or 2

MAWP = 1.2 · Op Press
Testing Pres = 1.3 MAWP
= 1.56 op Pres
Max Stress < Yield ~ 10,000 psi
Max bending < Yield

6061 T6 Al
No certification req'd
Press Safety Comm Approval (Bourque)
FEA, Hydro-test, & calcs
Shot plates
cylinders to benchmark
NSTec Req. Burst Press 4x MAWP

X-Div to ZP16

PI 2 week Review 7/23/08

25846 26170 W.140 - NIS alignment ?

✓ ✓ H8 pinhole - drop

✓ ✓ KB/micro #1 - "

DDRIC

~~NYNTO~~ } setups

NIS

2nd RD

✓ CPSS & WRFM#3 "

AudAor

SRF - Mon $\frac{87}{67} = 1.30$

Cryo Wed morning Shots

NSTec Wkly Mtg 7/23/08

Sapphire .4" for 3" clear aperture

✓ Radiaries

✓ NIF Press Regulations - Wolfgang?

✓ NIF software architecture → Amy

Bartha 202-586-7822

7/25/08

- GRA hire
- ~~* Sources Inventory~~
- ** OAP's PR
- ~~** Foreign Travel~~
- IEC IWD
- Trident EMP
- * DPP Paper Refs 8/8 — Francisco Benage, Sangster Rygg
- CPR 9/20, Exp Cntrl, Form Hot
- ✓ MIT → yields, D_2 ^3He
- * PMT Analysis
- ✓ QX1 ⇒ Cooley
- * SRF's Fill Press
- ** X-Div Allocation - Lori
- ✓ LAUR - Preshot
- Badging
- IEC FPGA controller
- POPS conformation
- Appraisal Input 8/18
- Grondalski proposal
- APS Membership
- Feedthrus
- Travel

Sig ∝ Input QE · G

$$\text{Input} \propto \frac{Sig}{QE \cdot G} = \text{const}$$

$$\frac{Sig_1}{QE_1 \cdot G_1} = \frac{Sig_2}{QE_2\, G_2}$$

$$\frac{QE_1}{QE_2} = \frac{Sig_1}{Sig_2}\,\frac{G_2}{G_1}$$

Dinke 1.1 1.5 $\frac{.9}{2/3} = 1.35$

Abney

NSTec PO - $15K balance

X-3 - reallocate to ZD-16

Mirrors - $27.2K

Travel - Omega Sept × 2 + 4

UK

Sapphire Window - Swiss Jewel Co

W38.00 $31.05 1.5" dia × .04"

W38.10 $89.95 1.5" dia × .125"

will quote UV grade

Warren Garbett 7/27/08

— 362 7/e , 5% thicker, 1% larger
4.63–4.89 wall thickness
21% ↓ in yield due to wall thickness
for clean & full lines, independent steps

— 10–15% deviation from normalized yield

4% yield variation in top 4
10% " 7

Colin sent PMT212 specs?

$x^{5/60} = 2^{x/92}$

7/30/08

Xrays : 2x x-ray energy of 5 vs 9keV

E(keV)	laser	bounce	valley	bounce/valley
9	1.1×10^{-9}	4×10^{-10}	1×10^{-12}	400x
5	1.1×10^{-8}	8×10^{-9}	2×10^{-9}	40x
5/9	10x	20x	500x	.1

Langenbrunner

NIF bkgnd calcs

granite isotopic comp & density

DTRA '08

7/30/08

1 week ?1 Brief

SRF's :

- Update target ID's

QX1 - 6x

- incorporate cable chars into standard cables

NSTec

7/30/08

P4, 18" port w/ 6 & 8" flanges

Aug 21 meeting

Sapphire Windows

Swiss Jewel Co   4-5 wks   UV

W38.00 1.5" dia x .04" $31.05   X 1/8" 75.60

W38.10   x .125" (3.2mm) 89.95   .04 68.60

– will also quote UV-grade, min 5

Newport

5.08 cm (2") dia x 2mm $656

Red Optronics

3 cm (1.18") dia x 2 mm

– will quote UV & 1 mm thick

ISP Optics

AL-W-38-3 1.5" dia x 3 mm $159

Duke 8/14/08

5 MHz

200 ns / e-pulse

20 μs / γ-pulse

TDS 6124 - 40 GHz, 45 ps/pulse, 10^6 pts

25 μs → ~1 γ pulse

NSTec 8/14/08

Battery specs & monitoring

conduit instead of all fibers

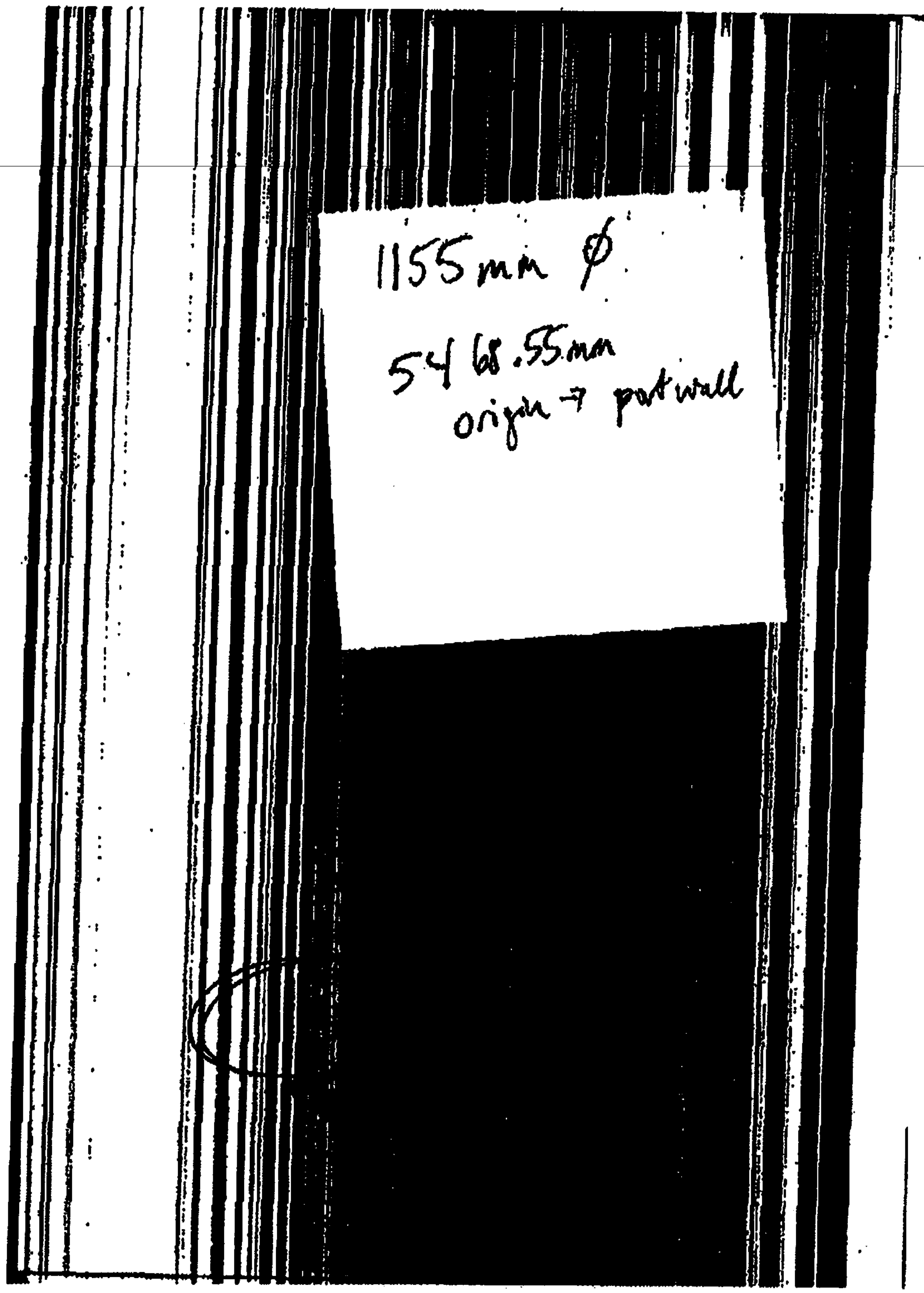
modularity

W Shields

Iris calibration

Stoeffl 925-980-0433

Turnell 663-2012
Malone -2014


1155mm ∅
5468.55mm
origin → portwall

IEC Visit to Park 1/23/07

Dankey
26311
482-2264

- 10^{-7} torr base press
- e^- emitter
  keep under vac
  need to be wired
- notebooks in JP's boxes (Bingalow)
  in lab?
  heat up slowly, start ~1V
  .1V for ~20 min
  keep < 10^{-5} torr
  eventually get to 9.5V
  ~ 2 days to condition emmitters
  \$8-10k for set of emmitters
  Heat Wave
  Barium impreg Tungsten
  2×10^{-6} torr for POPS operation
  $<5\times10^{-6}$

film badge for Rick

- Emmissive probe - in desk drawer ¼" Alumina
  double grid? ≈1Ω top
  HV feedthru bottom & side!

* ILIO Wrkplng / Z-code / workplan
Petrusso
* IEC PEA
* IWD
May Shot Plan
* Duke PR
* LAUR's (HTPD, NIF Wkly)
HTPD Travel
Warner Paper
* Travel - LLNL, Omega
Trng - Ann Sec Ref (6/20)
RAD Elec (5/18)

* Form 1963, ComForce
Student Hire

Terry
40882

Vandemann
661-1724

664-6947 · 7/02
Liz Athamptyh
Amy HR
231-6395

H. Herrmann
505-665-5075

OfficeMax

Steno Notebook

97333

60 Sheets • 6" x 9" • Gregg Ruled

Recycled Paper • Meets United States Government Requirements

40%

FROM 8/18/08	6/12/09
TO	
NO. 4	

Distributed by OfficeMax

0 11491 97333 9

8/18/08

GCD Modeling

1. Al-target GCD response vs 16.7 MeV
~~1 MeV secondaries~~
~~hohlraum spectrum~~

2. Shielding
(1 MeV Sec
(hohlraum spec
(PMT
(Window

- Sapphire (Al_2O_3) may have Cr impurity that fluoreseses

Doug Wilson 8/18/08

7/15

~6 THD shots · Aug 2010 ~ 1.5 months

2 ignition attempts Sep 2010 ~3 months

Measure slopes:

Ignition: $5\times10^{14} - 5\times10^{15}$ n/ns & $5\times10^{16} - 5\times10^{17}$

THD: $1\times10^{15} - 1\times10^{16}$ n/ns ← ~35

L=1%

→ p/c ~ $10^{21} - 10^{22}$

8/18/08

- ~~Budget, Doc's~~
- *~~PMT, Mgmt PR's~~ 9/5
- ✓ ~~Filters~~
- ✓ ~~Wilson - mtg 8/28 125 ~~123~~ 9904~~
- *~~Tring~~
- ✓ ~~T&E corrections~~
- *~~Apparent~~
- ~~Ign Drag Analysis 9/4~~
- *~~AcPonq~~
- APS ~~Pole~~, Mem
- ✓ Trident EMP
- TT NDE w/ CEA
- NIF Software, Drew ltr
- ~~CPR 9/20/6~~
- *~~Any hits 9/3~~
- ✓ ~~GRA hire~~
- *~~Y... Eval~~
- PoP DTRat Paper
- NIF CPR
- Z forecast
- *~~RSI Prod/Copyright~~
- Fulton/Barnes Smrn

- PMT analysis
- * GRH Reg's
- ~~Spares~~
- LLE Rpt 10/6
- BR analysis
- ~~Omega CDR~~
- PABS, X-ray Imaging
- ~~Crane - George Ortiz~~
- *- McEvoy Trng 232377

Appraisal

- NIF wkshp
- NIF GBT/RHD - CDR
- Ride alongs - May, June, Sep
- DTRA - Safety

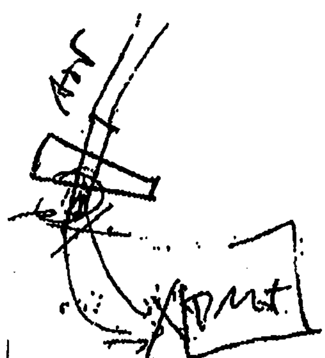
- IEC - IWD,

- Confs - APS - Orl, HTPD - Alb, NEDPC, IFSA
- Papers - RSI (IFSA), NEDPC

GCD UTC 8/19/05

HV cables - stripped,
- Sanchez
TDR of the arc?

Colin's ordering from Photek:
non-gated 110
gated 210



sts:
on window
Swap every yr
hydro-every 2yrs.
Protective layer on window

Dec 11, Feb 11,12

Training

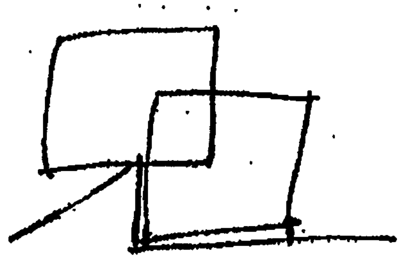
Joe doesn't need Vault Type Room

14847

-OF 1425'

GCD-2

Notch filters at 3ω, 2ω, 1ω



NIF Quad Req's 8/19/08

- 4 detectors w/ clear los w/in 50cm aperature located at 5.7m

- EMP shielding
  external – faraday cage...
  Internal – ecocorb

- Dynamic Range
  Variable Ap or ND filters

- Optical Alignment

- Calibration

Photek PMT's - Sydor 8/20/08

Mike Pavia 585-278-1168
SMA or N type?

Julie Fooks
Plastic Capsules
D_2 - 10 hrs, ID - 820, 15μ wall

No shipping method for mounted targets

Financial

ZD-15 : $410k asked / $14k spent / $68k budget
$121k asked
ZD-16 : $19k spent / $102k budget
($76k → NSTec PO)

Morag Smith 8/25/08

Mayo:
160 proposals = $5M
reviewers ~ 9 new starts, ~8 continuing
- good team w/ UW
- spherical ok, but linear + cyl - stability
more power? needs more thought
- weak argument, no modeling to support new config
- why better than other approaches
- Fieldability

Morag
- probably shouldn't push w/ Mayo

[illegible]

Student Hire :

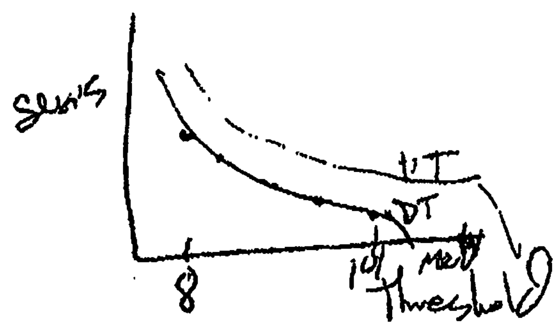
- Sup Emplmnt Frm 902 - from Aaron
- Transcripts (or ltr of acceptance to PhD) - from Aaron
* Student Workplan
- Mentoring Checklist for Student Interns

- offer letter ?

Doug Willson

8/27/08

- HT vs DT sensitivity
- Setup Sheet



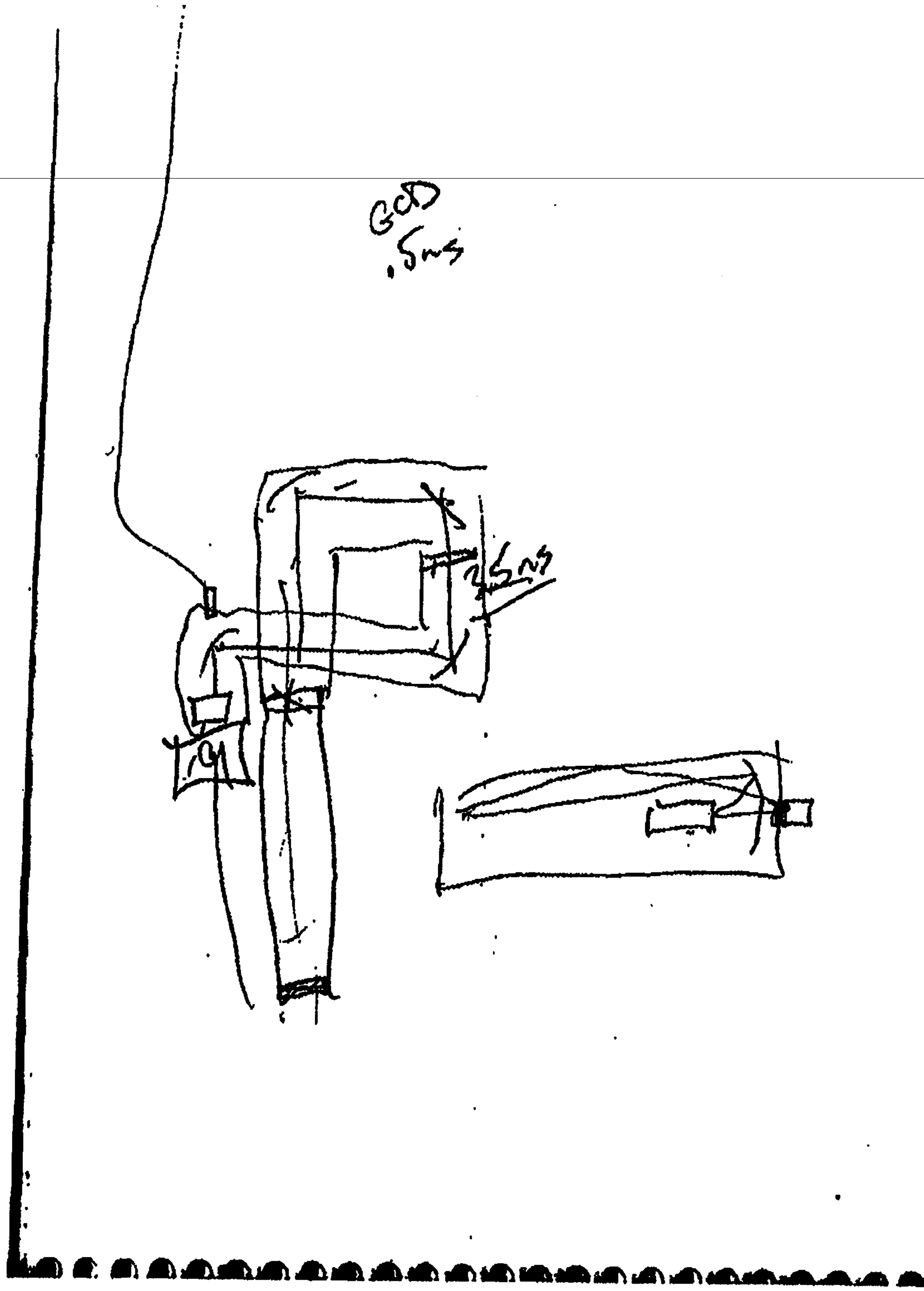
8 MeV
17 MeV

Poisson? $\sqrt{n}$
combined statistics
Reentrant tube

50kJ ~ 1.5×10^{16} n
3×10^{17} = 1 MJ

3×10^{7} n

discern leading edge slope
NIF Quad sens ~ 3×10^{4} n in 100 ps
~ 3×10^{15} n/ns
Can we distinguish betw 100 & 125 ps falls?


GCD
.5ns
3.5ns

9/2/-8

GST/RHD Data Analysis Presentation:

- Invert threshold curves - GCD
  $E_{?}$ vs. Sens → E_{th} vs. Sens
- Quad Sens.
- Find all GCD - 1 min m-? for 100 quanta (~10^?)
- Poisson Error
- Branching Ratio
- Set up Parameters - Bos, Press, ND/Irrs,
  PMT (ple dia, QE(λ) Gain).

EBR, Wolfgang

- Tunnel - 663-2012 AFP
- Malone - 2014
- Kaufman 2034
- Batha 5-5898

$244k → NSTec
Glick - push PR

DTRout Targets - 30 total

mounted 5 - 0% He - 3 shot - 2 left

5 - 10% 2 shot 3 left → 1 to Green

5 36% 3 2 left

15 — 6 mounted

Unmounted 2 of each at LLE = 6

5 of 0% He, at CAM - 5

4 used for D_2 13ke

Available for Fall:

0% - 2 mounted, 2 unmounted at LLE, 5 at CAM = 9

10% - 2 mounted, 2 unmounted at LLE = 4

36% " " = 4

17

Marie Alma - ~~X3~~ XDP TBI, CI call

- Red Crypto
  LDCC
  TA3 1498 Rm 205D

9/29

- Mark Voss 70066
  RWP Vol alt, Thurs
- Shelly - Computer Support
  78595
- $40K SNL for BT from C4
  Gordon / Carlos

10/1

- Kirk - specify ME's?
- 30V, 25A - TA

Ig Diag VTC 10/2/08

Springer/Koch

ARC @ 150 keV ?

4 backlighters, ~every 100ps

1.2 kJ @ 1ps

2 kJ 10

2.45 20

3. 50

1st beam March '10 } 1st compressor

2nd May '10 }

3rd & 4th beam ~~mid~~ FY11 - 2nd comp

4 beamlets per beam → gives 4 frames/beam

NS Tec

10/2/08

- coating ~7 dys
  chromfilm
  electroless Ni -10db worse
- RF seal

- Sapphire = 5mm thick
  Order all up front for coating

- Hydro IWD? 12/12

  18 cm from convertor axis to
  port axis

- Cross channel signal should be sent
  over short (<2ft) fiber bundle

- Gas fill fittings (Scott → Brown)

- Steve Vernon at LLNL has extra MZ's

RIt Meeting 10/7/08

- Nov 19 preps
  - HV soln's → CDR
  - Seo target → CDR
  - Procedures for LLE, Responsibilities
  - AWE
  - PMT's
    - Drift test on all
    - Impulse Resp of Asymmetries
- Quad
  - CDR Thurs 11am
- QX1? → Nov GX1-3?

trip to AWE/Photek

GeD-1 vs Quad 5th connector at 5m

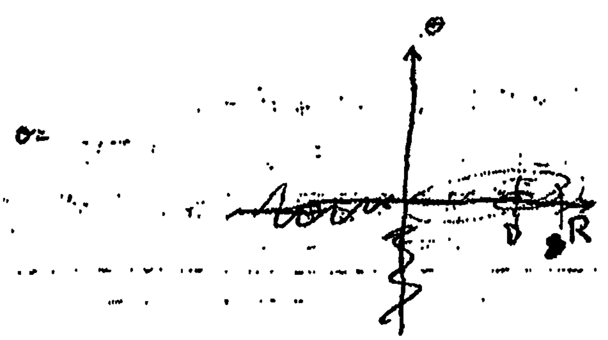
491 – Quad → 497 rest

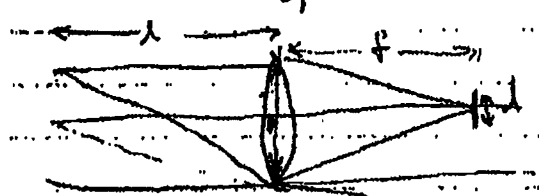
134 – GeD-1

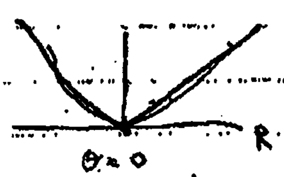
→ 524 by prev window

W half length ~ 1/2" for 16 MeV γ's

Footprint STEP file







$A = \pi r^2 = \pi(R_2^2 - R_1^2)$ $R_2 = R_1 + \epsilon$

$= \pi(R^2 + 2\epsilon R + \epsilon^2 - R^2)$

$= 2\pi R \epsilon \sim 2\pi R$

DT Rat

NTD
Gkm,

Omega CDR - MF Qual 10/9/08

Cox's slides:

Weight of W blocks?

10/8/08

Tunnel

- direct C-10 funding for NSTac 3
- NSTac Review next quarter
- Raffe Papazian - Stockpile Programs

- NLV estimate = $37k, 5wks, recharge?
  prev estimated $20k

- Rate Increase

$$\begin{array}{r} 1.02\ M \\ -\ .22\ \text{spent} \\ \hline .80\ \times 10\% \end{array}$$

80K

- Increased Scope
  - ND filters
  - Ω stand
  - fiber inputs
  - MZ
  - Travel

CDR

Pressurization manifold drawing
H8? 8" KB MICRO

Install page
bolt torque
- ORR - 4 wks ahead
- MZ eye protection review
- Comb generator spec → Jack

Wolfgang discussion 10/10/08

- Omega W holder redesign - accessible PMT
  - side fasten on plate
- PMT adjustment - force & back
  back side adjustment? wave washer on front
  threaded ring in back - indexed
  position may change from PMT to PMT
- Helium cable strain relief
- Flex conduit, cable connection access
  - how does R&D handle cables?
- Pressure flange - domed, no threaded holes thin
- Flange fastners - bolts, nut plates? threads?

~~fiber optic inputs~~

#10 screws
- extra mounting holes on front flange
  - tungsten plate on outside
  - mount parabolic mirror
- mounting holes on large block
  - strain relievers
- Rising comb to get fiber on scale w/ signal
- fiber optic inputs
  - may not be good to go thru ND filters
    but ok w/ rising comb
  - no pig tails, → ST connectors

- Erstati paper

Barthan 10/14/08

- APS Dry Run — Nov 4
- Raymost
- Elec Tng Pln, 7-DW - Tng Aaron
- Yongko's chmn mtg

USTec 10/15/08

- Gateable PMT? On or Off?
  drawing to Amy

[redacted]

10/15/08

- APS Reimb, Reg, Travel
- DTRad Paper, Talk - FABS, x-ray, CPS
- NIF ZDR
- Ω FDR

✓* ZD & EA forecasts, Request

- PMT drift tests
- GRH Req's Doc
- ~~LLE Rpt 10/6~~
- BR analyzers

* GRH Procurements

Halogen filaments 10/20/08
8A, 12V

ρR of hohlraum vs Al shell [illegible] capsule

hohlraum: $R = 500\,\mu m = .05\,cm$
$\rho = 2.7\,g/cm^3$
$\rho R = .135\,g/cm^2$

Uncompressed capsule: $R = 1\,\mu m = 10^{-4}\,cm$
$\rho = 2.7\,g/cm^2$

compressed capsule:
$\frac{R'}{R_0} = \frac{1}{30}$

Bathg 10/21/08

RRB - Rapid Release Blanket
Sedillo, Sandoval, TA, Phil

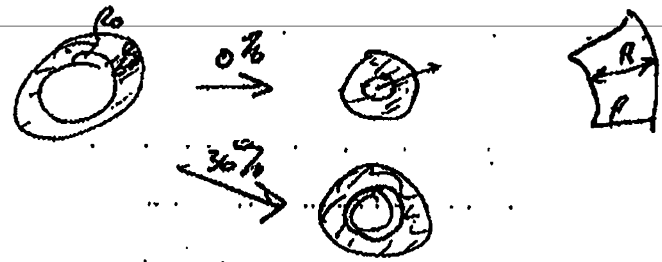
Put Jamie on ZD16 (100%)

NIF Quad:
Gco. $V_1 \cong 80cm \times \pi\ 6.3^2 cm = 10^4 cm^3$
Screw hole - $V_2 \approx .5 \times \pi \cdot .3^2 = .01$
$P_2 = 760 torr \cdot 10^{-6} = 10^{-3}$

Tom - Thurs travel, VB, & rag
Aaron - Sun
Nov 4 ~~VTC~~, 5pm, 10am
Fri

10/28/08

Shell ρR



$R_o = 4.9\,\mu m$

Aug '08

	No. 3/He	Good EOS 3/He	Worse EOS
Shock	1.75e12	5e11 30%	3.1e11 19%
Comp	3.56e12	8e11 20	8.1e11 23

10/31/08

Ω CDR — Air Hose
- air hose drawing → ZLE, Mit
✓ procedure adopt, Greg
- cable chain FAI from ZLE

Secondary target
- SRF - puck selection update sheet
- procedure update
- STEP files resend
- Mit to check beam clearance

WAPs to Greg

Cooley

11/4/08

* shot list to Jim
- GMX1.R
- Ti vs ^3He

	No He	Hi He Good EOS
Shock T_i ~ 8.5 keV	10.	9.5
compr T_i ~ 3.7	4.3	3.8

APS Dry Run

Hydro-equiv for fuller-stripped

Anomalous → Not predicted

Experimental Setup

Movie

Casey talk

- total yield reductions for ^3He

✓ George Sandoval - drawing

✓ Mo K. 663-2034 pager 2000

✓ Dawson 925-422-6781 dswift@llnl.gov

- change

Δ - 10:45 - 5:05, 3:20 - 9:13, 2:55 - 9:04

Orbits UA - 1:15 - 6:48, 4:38 - 11:48, 7:42 - 8:23

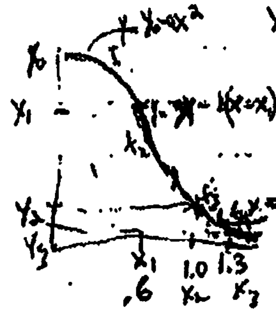
11/7/08

- ✓ WAP for AWE & (Dolly) Scott
- ✓ Jean Stevens for ~~[illegible]~~ Sedillo
- ✓ Travel, APS Memb
- ✓ Training Records

ATS Talk

- ✓ Slides 8 & 9 (Previous Results)
- ✓ 16 - Shock Plot
- ✓ TIRF
- ✓ Gamma Sens

Yong Ho cell 660-[redacted]3777



$y_0 - a(x_1^2) = y_1$ $a = \frac{y_0 - y_1}{x_1^2}$

$y = y_1 - b(x - x_1)$ $y_1 - b(x_2 - x_1) = y_2$ $b = \frac{(y_1 - y_2)}{(x_2 - x_1)} = 2ax_1$

$y_3 = y_1 - b(x_3 - x_1) + cx_3^2$

$c = \frac{y_3 - y_1 + b(x_3 - x_1)}{x_3^2}$

$y'(x_1) = -2ax_1 = -b$

~~$y'(x_2) = -b = -b + c$~~

$y_4 = y_3 + d(x - x_3)$

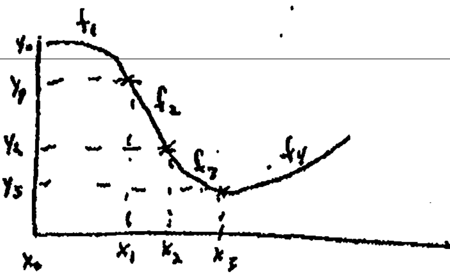
$y'(x_2) = -b = -b + 2c(x_2 - x_2)$

$y = y_1 + cx_3^2 = y_1 + dx_3^2 + e$

$e = x_3^2(c - d)$

NSTec

- Milt - PAID, Port
- Mirror mount order



$f_1 = y_0 - ax^2$, $f_1' = -2ax$; $f_1(x_1) = y_1 = y_0 - ax_1^2$

$f_2 = y_1 - b(x - x_1)$, $f_2' = -b$ $\quad a = \frac{(y_0 - y_1)}{x_1^2}$

$f_1'(x_1) = f_2'(x_1) \Rightarrow 2ax_1 = b \quad b = 2ax_1$

$\cancel{f_3 = y_3 + c(x - x_3)^n}$

$f_3 = y_1 - b(x - x_1) + c(x - x_2)^n$, $f_3' = -b + cn(x - x_2)^{n-1}$

* RWP

~~email transfer~~

11/20/08

GCD Wasshup OMEGA

- target holder unseated by ~ 5/8"
  could explain observed secondary & signal
- TDR cables
- Add Tom to cell pressurization authorization
- Order cable chain
- Air hose
  redo KF16'S on PMT can
- Cables RG-142?
- EMP testing w/ hard pulser (AFTEC3)
  starting press 99.9 psia ~78.7
- ending press 97.8 ~77.5

11/19/08

	Yield (e13)	Ti	
1	1.34	4.9	
2	2.23	4.7	
3	1.84	4.9	
4	2.46	4.8	
5	2.05	5.8	
6	3.63	6.1	Glass
7	1.54	4.5	
8	1.47	4.6	
9	2.22	4.7	
10	-	—	Empty
11	7.8e11	—	
12	.80	6.0	

n's across pack
.5cm at 5.19 cm/ns

$\frac{.5cm}{5.19cm/ns} = 96 ps$

RH = 450 ps

n's delay ~~at back~~

front: 4.5cm · 160ps/cm
720ps

back: 5cm · 160ps/cm
800ps

diff = 80ps

11/22/08

~~Hub Connect~~ - laptop battery
- UW Closeout
- Computer Reg
~~* Travel~~
~~** ICOPS~~
* Klippon highlight
- APS Mem
~~- IL FDR /NIF CDR~~
~~* GRH Update~~
* Hockaday - Abu Update
- PMT cals
~~* Team email~~
~~- NIF visitors 12/18~~
~~** LLE exp prop 12/12~~
~~** DTRA Review 12/12~~
~~- PerforM~~
~~- Security Tng~~
* P-DO SLAN - Sys Sec Plan
- Feb Travel
* QX1 pinholes
~~** Omega FDR~~
~~Air Hose - codes~~
- Young Travel

JL1K
JL DF - recs - operations - cable/controller
JL1B - materials - shields/...
JL1H - Symmetry - george, blue looms

JLDN -
JL1U
JL1G - ordered

Al target

$SA = \frac{\pi\, 1.5^2}{4\pi\, 5.8^2} = 1.67\%$

$\rho d = 2.7 \frac{g}{cm^3} \cdot .5\,cm = 1.35 \frac{g}{cm^2}$

$= 1.35 \frac{g}{cm^2} \cdot \frac{6.02 \times 10^{23}}{27g}$

$= 3 \times 10^{22}$ atoms/cm^2

Radiative capture (n, γ)

$\sigma = 0.5\,mb = \cancel{0.5}\ 5 \times 10^{-4} \times 10^{-24}\,cm^2$

$= 5 \times 10^{-28}\,cm^2$

Interaction Prob $= 15 \times 10^{-6}$

$= 1.5 \times 10^{-5}$

35 mb > 6 MeV (n, n')
Endf

$R \to 1.25$

$\rho \sim \frac{1}{R^3} \sim \frac{1}{2}$ $\qquad \rho R \propto \frac{1}{R^5}$

$\rho R \sim \frac{1.25}{2} = .63$

$R_f \propto \iint n_D n_T \overset{T^4}{\langle \sigma v \rangle}\, d^3r\, dt$ $\qquad P = nkT$

$\propto \frac{1}{r^6} r^3 T^4 \propto \frac{T^4}{r^3}$ $\qquad PV = nRT$

$\cancel{nkT}\, V = \cancel{nRT}$

$V = \frac{R}{k}$

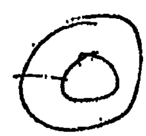
<u>shell ρR</u>

$Y \sim (\rho R)^3$ $\qquad T = \frac{PV}{nR}$

$\propto \frac{PV}{n}$

$\frac{(\rho_0 R_0)^3}{(\rho_1 R_1)^3} = 2$

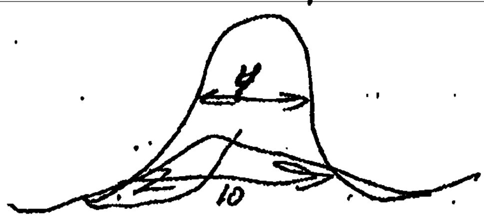
$\frac{\rho_0 R_0}{\rho_1 R_1} = 2^{1/3} = 1.26$



$\cancel{\frac{R_1^2}{R_0^2} = 1.26}$

$\cancel{R_1 = 1.12 R_0}$

nToF
ion Temp



D. Wilson 12/3/08

2kJ preheat into shell over time
hot e^-,
HXRD, 10^3 keV, LPI → hot e^- → brems

- Miller Collins 73311
Steve Clemens Design Authority Rep 70336
PD341 Engineering Processes
table 1, ML4
Jason Aperson

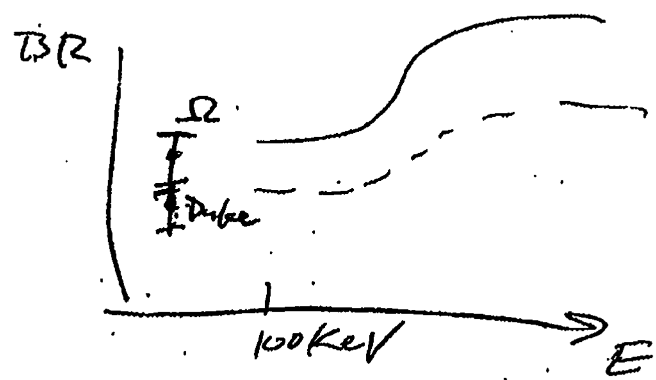
Borgne
- ½ press, 10% incr
available 12th

PaP Comments 12/3

Jamie

- 12 ppm upper limit
  CO_2
- Abstract
  GCD - Shock & Compr
- Discussion
  unanticipated vs unexpected
  unpredicted

Hsu results for 7mm Al thick, + Ammy
1 cm ϕ



N-spec

12/4/08

IMC

www.imcquality.com

call Bill Ramos
in the morning

505·872·3249

- IMC
  - send PO to Amy
  - Hand - p/u @ 11am
  - Swage order!

12/5/08

Cooley PoP paper comments
convergence w/ Press
mixed RH's - truncation, add fig
remove fig 7
burn rate & fusion?
hydro-equiv assump I vs e* directly
shock → ions
ρR is burn averaged!
Anomalous

JMC: Bill Eduardo
872-3249
Amy 505-220-5529

Mirosh Comin 61546

DT-γ E-spectrum sensitivity for BR!

Doppler $\Delta t = \overset{ps}{122} \sqrt{\overset{keV}{T}}\ \overset{m}{d}$ at 12 m $= \begin{matrix} 3.3\ ns \\ 3.7\ ns \end{matrix}$ for $\begin{matrix} 4\ keV \\ 5\ keV \end{matrix}$

4.8 ns 10 keV

SBTS .2 ns

$$G = a e^{-(x-b)^2/2c^2}$$

$$fwhm = 2\sqrt{2 \ln 2}\ c$$

$$c^2 = \left(\frac{fwhm}{2\sqrt{2 \ln 2}}\right)^2 = \frac{fwhm^2}{8 \ln 2}$$

$$\cancel{G = a e^{-(x-b)^2 / fwhm/\sqrt{2 \ln 2}}}$$

$$= a e^{-(x-b)^2/(fwhm^2/8 \ln 2)}$$

~~AR~~ AV/F Swagelok 12/9/08

GMT 12/9/08

- Security Trng by 12/17!
- Perform 12/19
- Chem & Prop Inv

12/12/08

DTRnt '09 Readiness Review

update goals & diagnostics
DIME wants GMX / - time integrated
Grim

GMT 12/15/08

- T&E approvals for Dec 22, by 10am on Mon
  can be entered by Lucy, Celine & Rosa
- DR titles to Juan, meeting on 12th
- Perform employee inputs by 1/9
  trng w/ Seertom on 12/18
- SLAN approval

[redacted]

NIF Ignitron Diag VTC 12/16/08

ρR, ρR (hot spot), Ti

- 1st ch Feb ...
- EMP w/ Joint EP
- timing cal
- cable runs & EMI racks
- reentrant tube

THD

T:H:D = 3:1:.03

Carl: Al Puck at 4.4cm, 3 cm ϕ 12/17/08

$\Rightarrow 3\times10^{-7} \frac{\text{det Cp}}{\text{source n}} \times 2\times10^{13} n = 6\times10^{4} \text{ det Cp}$

~~6×10^4 det Cp~~

DT-γ $1\times10^{-5} \times 1.3\times10^{-3} = 1.3\times10^{-8}$ BR

$\frac{\text{Sec}}{\text{Pri}} = \frac{3}{13} = 23\%$

Seestrom PerforM 12/18
Performance Management Process
Workbench
mid your [illegible]
Jan 9 - first draft
30 - discussion
30 - Employee acknowledgement

HRPMG Authority

NSTec 12/18
- adapter flange at LANL shop

NIF – Fortner/Kilkenny

12/18/08

Duke availability

Direct Drive DT exploding pusher at NIF

Dec '09

– Memo on HT gamma

$\cancel{m_1 v_1 = m_2 v_2}$ $\cancel{E_1 = E_2}$

$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$

$v_2 = 0$

$m_1 v_1^2 = m_1 v_1'^2 + m_2 v_2'^2$

$m_1 v_{1x} = m_1 v_{1x}' + m_2 v_{2x}'$ $v_1^2 = v_1'^2 + \frac{m_2}{m_1} v_2'^2$

$v_{1x} = v_{1x}' + \frac{m_2}{m_1} v_{2x}'$

$v_{1y} = v_{1y}' + \frac{m_2}{m_1} v_{2y}'$ $v_{1y} = 0$

$v_{1y}' = -\frac{m_2}{m_1} v_{2y}'$

head on $v_{1y}' = v_{2y}' = 0$

$\left(v_1' + \frac{m_2}{m_1} v_2'\right)^2 = v_1'^2 + \frac{m_2}{m_1} v_2'^2$

$\cancel{v_1'^2} + 2 \frac{m_2}{m_1} v_1' v_2' + \left(\frac{m_2}{m_1}\right)^2 v_2'^2 = \cancel{v_1'^2} + \frac{m_2}{m_1} v_2'^2$

$2 v_1' v_2' + \left(\frac{m_2}{m_1} - 1\right) v_2'^2 = 0$ $v_1' = \frac{1}{2}\left(\frac{m_2}{m_1} - 1\right) v_2'$

$m_2 = m_1 \longrightarrow V_1' = 0$

$V_2' = \frac{m_1}{m_2} V_1' = V_1'$

$m_2 = 3m_1 \longrightarrow V_1' = V_2' = V'$

$m_1 V_1 = m_1 V + m_2 V = (m_1 + m_2) V$

$V = \frac{m_1}{m_1 + m_2} V_1$

$V = \frac{1}{4} V_1$

check: $m_1 V_1^2 = m_1 V^2 + m_2 V^2$

$m_1 V_1^2 = \frac{m_1}{16} V_1^2 + \frac{3m_1 V_1^2}{16} = \frac{1}{4} V_1^2$ X

NIF Ig Diag VTC - Edwards 12/23/08

Diagnostic Activation Dec 09?
DD DT @ ~ 1x10^{15}
Gold ball rod shots

May 11, 12, HED P & F Capability Review
morning session on NIF/ARC
Cris Barnes organizer
20 min presentation

WWG in Feb or March?

1/5/09

- ~~ICOPS Abstract~~
- ~~Shipment to Julie~~
- ~~FDR~~
- ~~Travel~~
- ~~PMT cals~~
- ~~Duffy response~~
- Q201
- TDR

GRH FDR 1/8/09

* laser registration w/ Tim
* Sirtense certification in procedure - by email to Tony
- capture port cover
✓ H8F port cover thickness to be checked by ZZ
✓* "Lift here" stickers

✓* SRF to Greg
✓* Op Proc, Qual Proc

✓ - ORR 1/13
✓* ethernet info to Jack, Alan? Shechter
sh
✓ - directions to Mo

Mo, Scott, Zaheer, Hans

Dentists
Heisch, Gartz, Rsannon

Steven Dyer - AGE Safety

1/20/09

~~LANL Trav ID - Ctm~~
~~NST-7 Funding~~
IEEE Review
* SRF's
*✓ TRF
~~* Foreign Nat'l Access~~
Hsu badge
~~* Travel~~
* PoP revision
Jamie laptop
✓ laptop battery
* Highlights ⇒ Bertha
PMT cross cal
~~* Targets to Valdimore~~
* LLE visit req - Schmitt
* PerforM
PMT cals @ Trident ?
NSTec AFP
Edwards GRH memo
ICOPS sponsorship
$5k from JLDF, JLIM
Mendes, & Doug

RH Meeting 1/20/09

- Travel plans, LLE notification
- GRH update
- Duke press scan? Feb 11
- Impulse Response on Mar

- Mac for Jamie

PMT cals at Tri-lent 1/22/09

green probe beam, front end
< 10ps
Fiber to N or S target bay
March 30, 31
discussed w/ Sam & Dave

NSTec GRH 1/20/09

- GCD-1 press transducer ?
- PMT cup, LANL shop mistake → Apr
- Trombone → Apr
- Mirror Flexure → Apr
- Fibers → Apr
* Fiber bracket & shroud → Feb
- Conduit → Apr
- Coatings, RF o-rings → Apr
* Press, Temp → Feb
  → 1/4" NPT

Wilson

Ignition HT 1.17×10^{11} thermal 1% H_2, 3050 DT
DT 6.12×10^{18}
4.68×10^{12} knockon HT
1.8×10^{14} DT γ's

$$\frac{HT_{th}}{DT} = \frac{1.2 \times 10^{11}}{6.1 \times 10^{18}} \quad 3 \times 10^{-5} = 6.5 \times 10^{-4} \times 2500$$
$= 1.6$

.2% D - 4×10^{4} DT-n

$\frac{HT_{th}}{DT} \sim 8 \rightarrow 3.2 \times 10^{12}$
6×10^{12}

1/22/09

Ignition VTC - Diagnostic Activation
DD ~ 10^{14} n
Dec 09
4 keV

EMP
H_2 addition for 19.8 MeV γ's
System shots for timing cal's (gold ball) (not "Real" shots)
- CDR in March for diagnostic activation plan

Diag workshop Feb 17, 18

GMT 1/22/09

- Classified doc markings - Kline, Kyrala
  starting Feb 23
  LACP's require signatures
- Safes outside of 87 room?
- Dosimetry
- IPO's Perform
* OCE - Yongho's lab computers!

THD 1/23/09

~~25 ... 75~~

= ~~50:50 DT~~ THD = 50:50:.2

$$\frac{HT_{th}}{DT_{\gamma}} \approx \frac{\sigma_{HT_{th}}}{\sigma_{DT_{\gamma}}} \; BR_{corr} \; \frac{GCD_{20}}{GCD_{17}} \; \frac{[H][T]}{[D][T]}$$

$$= \frac{1}{1000} \; 4 \; 2 \; \frac{50}{.2}$$

$$= 2$$

T	H	D
50	50	.2

$Z+1 = 2(T+H+D)$ 200.4

$A = 3T + 2D + H$ 200.4

$$DT\text{-}n \approx 10^{14} \; \frac{.20 \cdot .70}{50 \cdot 50} = 4 \times 10^{12}$$

	T	D	H	3He
$\frac{Z+1}{A}$ =	$\frac{2}{3}$	1	2	1

Nobile → LP50 @ 900 torr 1/29/09

T_2 .2% & .3% D_2

.8%, 1.7%

Diamond Wst

Batha, Wilson 1/27/09
~~HEDP~~ + F Cability Review
- NIC Sessions
3/3 Laydown Tues morning
3/23 Dry Run Mon aft

- GRH Activation Plan
DT ~ 10^{14} n → Exp Scan
DD baselines
EMP
~~[illegible]~~ System Shots
X-ray ?

D_2 Oct-Nov
DT Nov

* HXRD from Oct '07 to Doug.

JLDF could support NIF PI activities
took in 3 DF cycles

LLE 2-week PI meeting 1/28/09

No XRPHC H8
H8 - 30ft hose
GCD - CO_2 bottle position

- TIM 6 emptied day before
  detectors in front of LOS
- WAP's email to Greg & [illegible]
- NTD position controller
  Christian Stoeckl

D_2He < 3×10^{11} ? 76.

NIF Drag VTC 1/29/09
THD 35 shots, $\sim 2\times10^{14}$ DT-n
→ Jan '10 (up from Mar '10)
Drag Act → Nov → direct drive ?
10^{14} DD-n in direct drive

EMP - Tubs
- broke
- Spring Break

NSTec 1/29/09

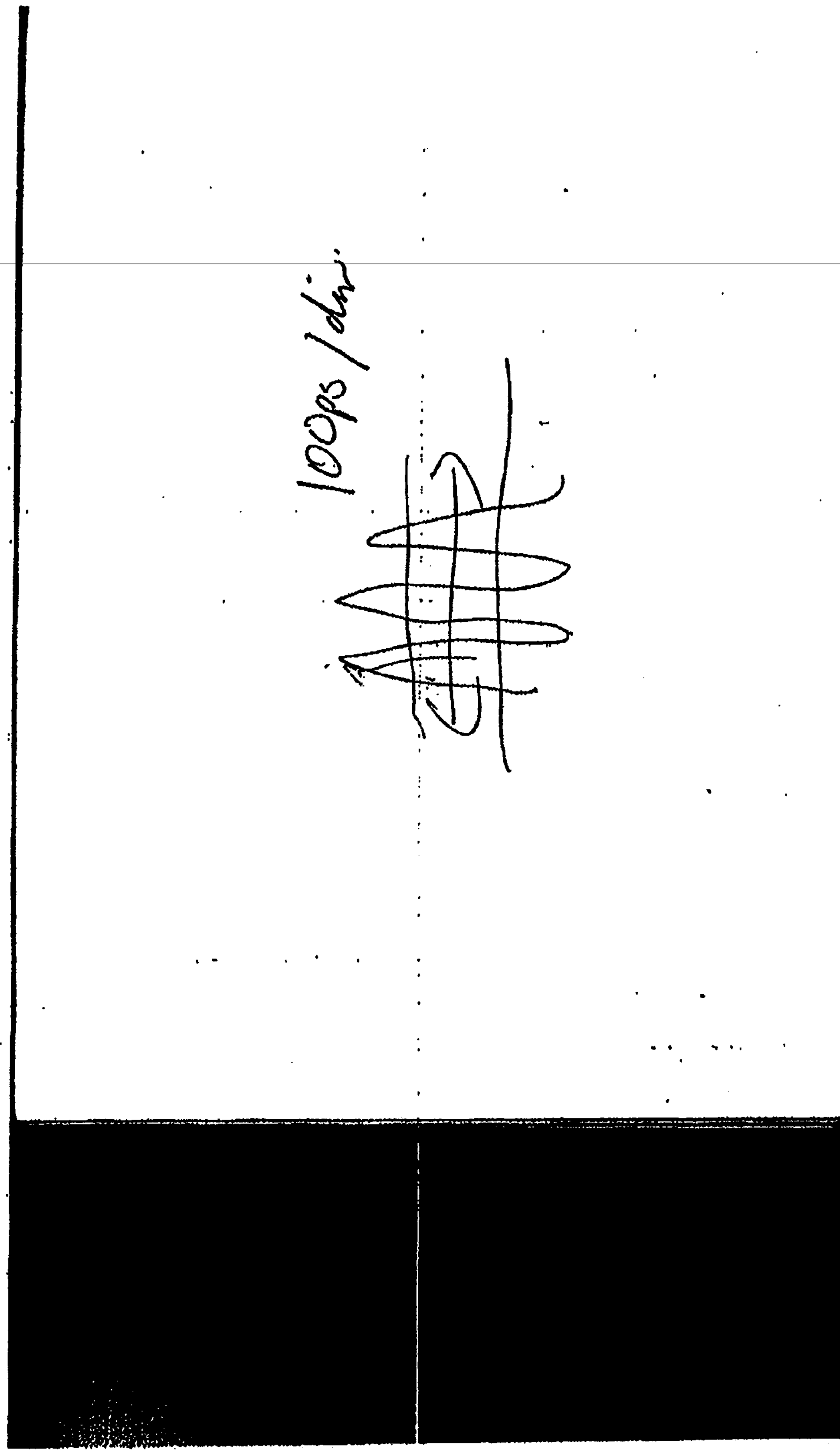
STEP, etc → LLE ?
GRH dimensions to Carl

To do Mon morning
Highlight → Kline/Buthn
LSRF - MS definition ?
Eudora Out
SmithEquip - Ben Bob Vefeomi
605 885 8296 8226

$n'RT = PV$

$n = PV/RT =$

585-275-


100ps /div

2/9/09

No H8 pinhole!

2/6/09

NIF workshop

- fusion req w/in 5% → not reasonable
  - 5% relative
  - 20% absolute
- Omega
  - EMD, hohlraum, THD, abs timing
  - software
- Fidu - ~~3~~ 2 uS adequate
- Facility - preshot warmups
- Wolfgang's spreadsheet
- Port? 26° above equator (64° down)
- Engineering support - Bruce Felker, Jeff Heslin, Zac
  - 2 ¼ FTE's eng, 2 ½ FTE's for
  - ~~3~~ months tec's (Zuhreer)
- FMEA?
- Commissioning

- 2ops [illegible]
- Mark Bevers Beeler? – software
  64', 241P – reentrant

nToF w/
— DD shots in Nov
  D³He
- Software [illegible]

100mV /div
ch 2.
-4600V

7×10^3 7mV.

$\frac{4 \times 10^5}{7 \times 10^3}$ 50x 350mV. $\frac{2}{7 \times 10^{-3}}$ x286

2×10^6 - 4300 -

1.8x $\frac{2 \times 10^5}{7 \times 10^3}$ 32x 210mV.

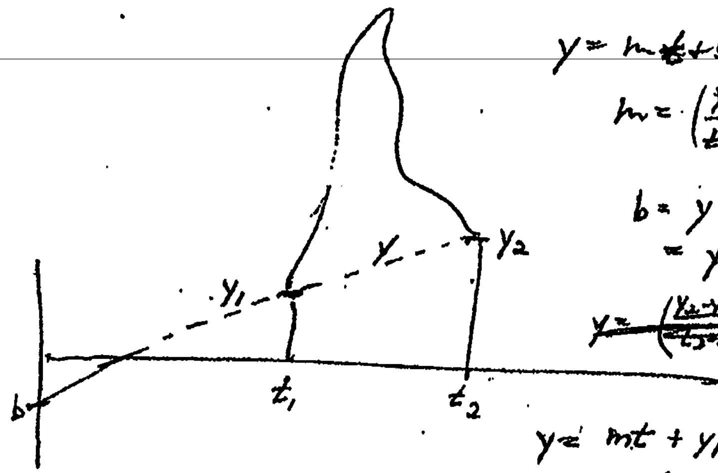
Omega Washup 2/13/08

* * procedural review - Scott, Zaheer
* — EMP - Zaheer, Mike
* * Light leaks - Mike, Bob
* * DTRoot Decons - Colin, Carl
* - Bang Times - Hans, Aaron
* - Proximity sources - Colin, Hans, Yongho Ω vs. NIF
* * Shielding redesign - Jamie, Yongho, Carl, Morris
* — PMT placement - Bob
* * PMT cals - Aaron

* — Stamp domed flange - Morris
* - N_2 backfill - Scott

* * Signal vs Y - Hans
* * GRH Sens - Hans

TS Rich Chartrand - Decon



$$y = mt + b$$

$$m = \left(\frac{y_2 - y_1}{t_2 - t_1}\right)$$

$$b = y - mt$$
$$= y_1 - mt_1$$

$$\cancel{y = \left(\frac{y_2-y_1}{t_2-t_1}\right)\left[t - y_1\ t_1\right]}$$

$$y = mt + y_1 - mt_1$$
$$= m(t - t_1) + y_1$$
$$= (y_2 - y_1)\left(\frac{t - t_1}{t_2 - t_1}\right) + y_1$$

Voice Mail 2/16/09

Gail Rosasha 7 0468 . optiforms
Chris Chandler - LANL council 5-5909
~~Mo~~ Mose Light mlight@lanl.gov 5-3566
Morag - lodging for 8 7

- PO Optiforms
Leticia, 6 1606.
✓ AWE visit requests
- Duke/Optiforms. PO
✓ GRH Wrinkle → Kilkenny
MCNP deck from Zach

3/2/09

GMT 3/2/09

- Chemlog - Yongho?
- NASA? Brian 925-422-4880
- Trng
- NA-22
- FWP to Glenn today! '11
- AWE 982's

Kirk Miller
DPO 7000 12.5 & 16 GHz
6124 12 GHz

NIM crate - Nuclear Instrumentation Module

Leeper
ICOPS

poster { 1033, 1291, 1299, 1302, 1515, 1705
1829, 1830, 1855, 1952

oral 1131*, 1796, 1318, 1635, = 1:15
↳ poster?

** AWE visit/computers
** Travel - LdrInst, LLNL, ICOPS, IFSA
Electronics enclosure - mat'l. & assorts
~~* C-10 Highlights 3/6 - Patlin, Peter, Abner~~
NIF MCNP deck
~~* Dreter~~
~~* Leadership book thomas 2/22~~
~~* ICOPS~~
IP Scan Vulnerability
~~* DGL Screening 3pm~~
~~* GRH Error Analysis~~
~~* LI preps~~
~~** PTR~~
~~** Z budget~~
Ω GRH procedure
* HBDP4F abstract & laydown
~~* IEC Stimulus Prop~~

GMT 3/16/09

- Kem, 3 chems
- Training - ISSM Klave, Pursley
  9661 - Int Safeguards & Sec
  CPR ?
- PTR's after Feb 9
  DL controls
- NASA
- Perform mid-appraisal - end of Apr
* Rosocha ? - move to bullpen, postdoc in May
- GRH
- DGL Interviews
✓ Norm Q - renew
✓ - Mack Szafir - assigned to me
- Evans DOE award ? Zaheer
✓ Chandler
✓ EMC2
  AWE

* Klare - George & Jim - do they need him

RH VTC 3/17/09

* Ω CAD → Rubery
E threshold ↗
Apr tasks, Trident
* THB comparison overview
Bkgnd measurements

GRH CDR 3/17/09

- have Doug check before pressurizing
- rotation? STEP file
- SRAW, weight = 238 lb

Puck
- Procedure
- SRE matl's
- holder in 182

Action Items
- Proc changes!
- ORR 3/25
- NTOF Rm Interference? STEP file → M/T
Index marks
- SRAW, press at LANL

[redacted]

GRH Priorities 3/18/09

Apr 8 - Shielding
Puck expt's

May 4 - EMI - conduits, rack, enclosure
(BMTEP) fidu - tuned & atten'd extra PMT?
*MZ - electronics & scope
May 12,13 - Puck expt's.
Aug - X-ray timing cal - scintillator, ND or aperture
In-situ impulse & sensitivity cals
* laser light timing cal?

NIF 925-42# 3/18/09
John Edwards 21187
Klishia 34029
Kyrala 20441
Wilson 39904 381-2102
2140

X-ray mfp through Al
50keV λ = 1cm
25 = 2mm
70keV K-edge
Wilke 699-7589
George Kyrala 699-0993

HEDP & F Laydown 3/18/09

- use template
- final to Karen 4/13
- ~~F~~ Final dry run 4/6
- 10 min talk, 10 min questions
- Abstracts due Fri to Karen
- GRH Highlight Slide to Klein
- Optimization in design
  GCD → GRH

* Engineering NIF drawing w/ GRH
ARC comes online Jul '10

Jan 07 - George's gold ball shots

TT n spectrum
cuts off ~9.5 MeV
~~Ask~~ 10-12 MeV to avoid TT
but 6-10 MeV could be of interest

burnup fraction = $\frac{\rho R}{\rho R + 6}$ = 1/8 for ρR = 1
1/4 2
1/3 3

35×10^{17} = 1 MJ

NIF Diagnostics Workshop Followup 3/19/09

hohlraum.. May-Jun

capsule ~~May~~ ~~Dec~~ Oct

THD - Apr '10 w/ Be
Jan '10 CH capsule 10 shots

Minimum parameters
need: ρT, HS size & shape, Ti, Y, dsf
desired: BW, ...

$ITF \sim (Y\,dsf^{2.3})^{1.25-1.75}$

Bang time
Xray & ~~nTOF~~ cut out ~ 10^{17} n yield

hGXI works at < 10^{15} n

GRH-1 (=GRH-6m) scheduled for Jan '10
need by Mar '10
eng resources free up in May '09
✓ get gold ball x-ray flux from Edwards

Hotel ibahn. internet connection 3/20/09
- IE - options - Connections - LAN settings
Uncheck "use automatic configuration script"
then connection was made by IBAHN operator
IBAHN case # 1509425
appeared to work initially, then died!
5/7/09 $\boxed{1553047}$
3/22/09
~~threaded rod~~

MZ 102 75
Coax 135 75 ~ $4054

3/23/09

GMT

- stand alone accreditations
  → register! hostmaster vs. sunflower
- passwords, 4/30
- PTR's
  Contractors must have need expressed in contract

BW(GHz) · FWHM(ps) = 350

BW	FWHM
1 GHz ⇒	350ps
3.5	100
12 ⇒	

RH Meeting 3/24/09

Holtham Pt Design
. Computers

Budget
Allotment $200K for FY09

- SRF

3/24/59

* Order MZ parts
- ~~Travel~~ – ~~AR, IFSA~~ expense – UNL, LI, AR/Ros – Yale/ELE
- AWE computers
- ~~Wire to Yongho~~
* IFSA abstract
- Puck procedure & SRF
- X-ray scint
- ~~D10~~

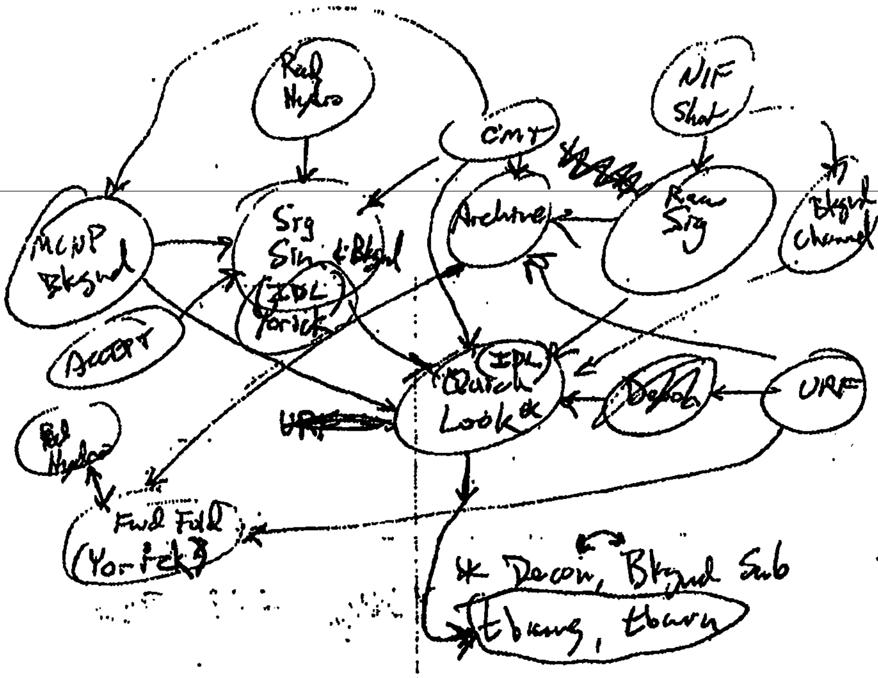
[redacted]

Ignitron VTC 5/26/09

TMD in March '10
Drag commission w/ DT in Jan - Mar '10
- 6 tuning shots in FY 10
- 6 high yield DT.
Da, D3/He

* Computing Access
* Can Access for 1yr

Software


Rad Hydro
NIF Shot
CMT
MCNP Bkgnd
Srg Sim & Bkgnd
IDL Yorick
Archive
Raw Sig
Bkgd channel
ACCEPT
IDL Quick Look*
URF
Rad Hydro
Fwd Fold (Yorick)
* Decon, Bkgnd Sub
tbang, tburn

NSTec 3/26/09

Trombone coating?
grounded T/C? press thus?
Febatron?
X-ray
Isometric
GRH-14m

Feb AFP $185k

NSTec 3pm Thurs

(R) on Vasco, on (L) past Citgo-Northern
161A Vasco Rd. (Jack in Box across)

M. Schmitt 662-5268
5-7522

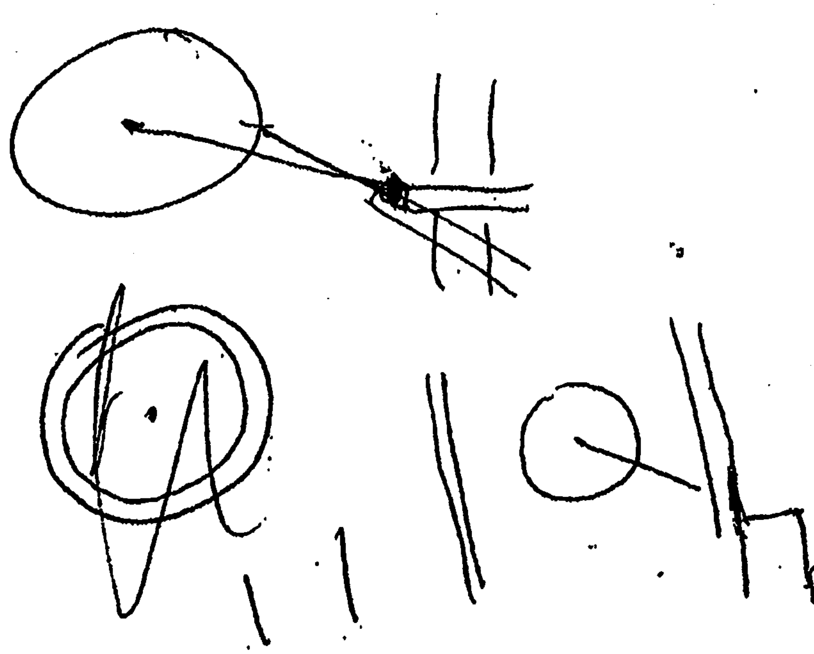
Badge Off - 76901
1745 - Badge Reg Form

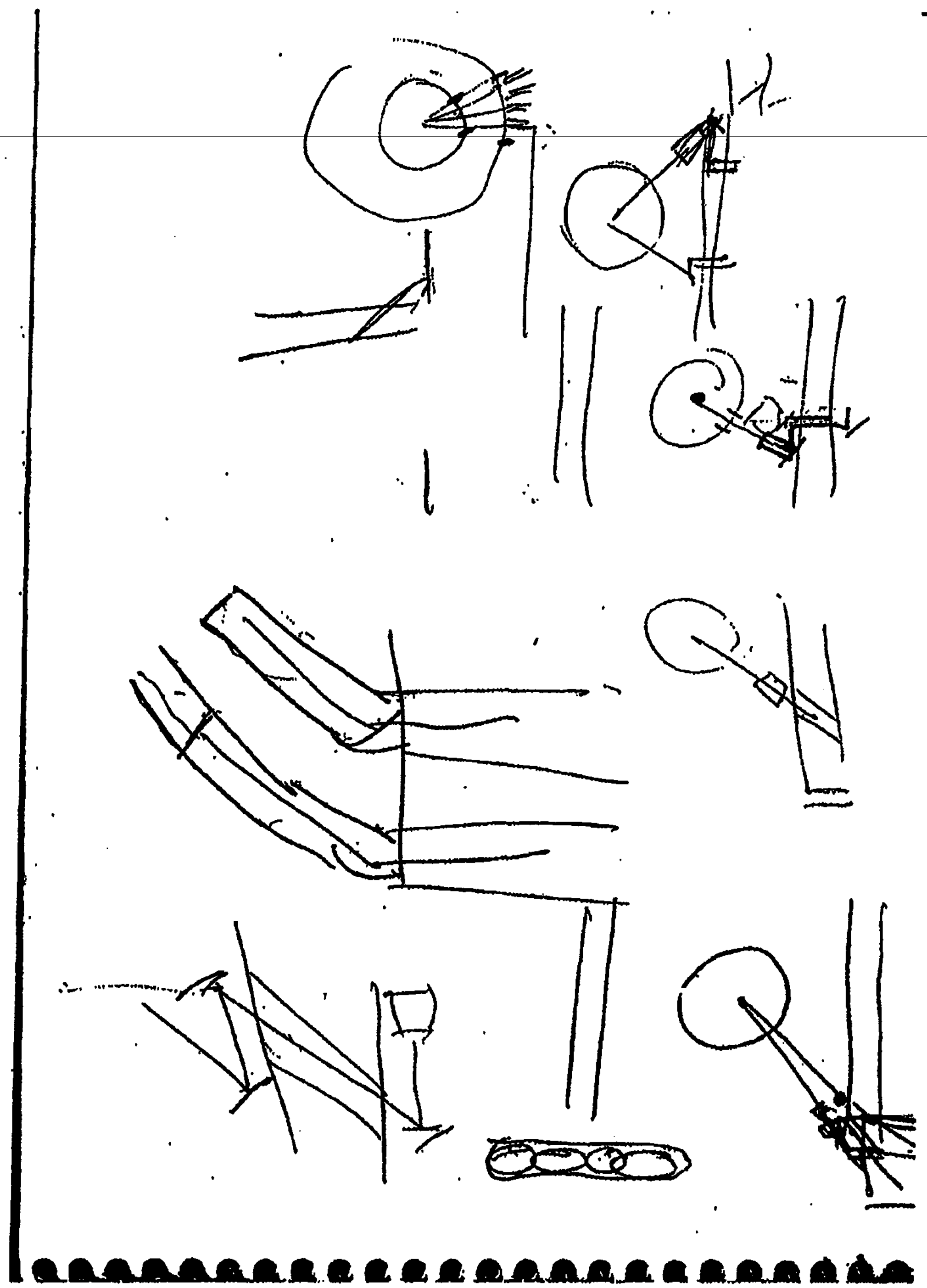
4/2/09

Ignitron VTC - Modeling

- Any additional noise sources for GRH?
  pointing, conv thickness, shot-to-shot VRF variation

4/13 - Diagnostic modeling description / CMT
5/4 - tests in hydro
June - THD optimization M/U SimCam





NIF Target bay 4/3/09

GRH-6m:

(64, 241) - tight access thru vac pipes

309, 219, 136, 111, 39(?), 20, 5

open future DIM open

45m

nToF's - 330, 309, 275, 253

GRH-14m

(77, 24, 38) - CIVS flexible view, [redacted]

Chamber Interior Viewing System

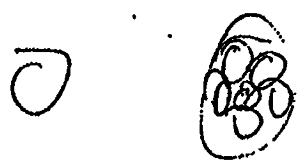
@googlemail.com

[redacted]

MF Ig Drug UTC 4/9/09

Sim Cam - Jun - 1st wk
Input parameters

Zaheer cell - 585-402-1261



200eV over 1cm

$$V=\sqrt{\frac{2E}{m}} = \sqrt{\frac{.4}{500}}\,c = .028\,c$$

$$t_{pmr} = \frac{d}{v} = \frac{1\,cm \cdot s}{.028 \cdot 3\times10^{10}\,cm} = 1.17\,ns$$

$$t_n = \frac{1.7\,m}{\frac{3\times10^{8}\,m/s}{6}} = 34\,ns$$

$$t_\gamma = \frac{1.7}{3\times10^{8}} = 0.57\times10^{-8} = 5.7\,ns$$

$$t_{cable} = \frac{40\,ft}{\cancel{1ft}/1.1\,ns} = 44\,ns$$

5/10/09

* Travel
* MZ (frdis, May props, PMT 110? ecosorb?
~~DTRad → Gold Ball!~~
~~* Ship components to [illegible]~~
- Laser training
~~* Laptop vulnerability~~
~~* CDR~~
~~* HEDP&F → [illegible]~~
~~** IFSA Abstract 4/5~~
* LLNL VPN
~~Gold Ball [illegible]~~
- DPO Scopes ?
* Malone IFSA LAUR
~~* [illegible]~~
Conduit & adapter, BC422
* COS, ET, FT
- Highlights
-

RH Mtg 4/14/09

MZ filters need x-ray shielding
metal conduit, steel jacket
soft x-rays
no electrical conduit

Jcn Box
ST → FC fiber connectors (Moleso 3)
PMT cable length
* GRH procedure → Kirk

Fidu → Keith
- filter wheel
Press/Temp
* Photo's of GRH → Kirk

Duffy 4/16/09

CDR
- Footprint in LaCave
- cable diagram
- Purpose of MZ
- ~~Cable diagram~~
- Doug, Sam, MIT, Meyerhofer
  - ORR 4/27, CDR 4/21

Ig VTC 4/16

Direct Drive for Diag Commissioning, Jan '10

10^{13}–10^{15} neutron yield

target 10^{14}

200 kJ peak, clip back to 100 kJ

1.6 ns fwhm Gaussian

45% 40C done on Omega

10 atm DT

1.5 mm, 4μm glass, Hoppe

Polar Drive

late summer at LLE

~5 D_2, 5 DHe^3

[redacted]

Edwards: 4/16/09

SimCom

- red teams meet by end of month
  decide on "errors"

GRH Red - Stoeffl, Leeper, Stoekl, Mook? LANL?
Blue - Herrmann, Grim, Schmitt, Wilson
Young, Horsfield, Langenbrunner

Wolfgang

GRH Prj - Development → Operations

- take diff btw 6.5" & 9.5" + bot → direct slice after BT
- # Gammas?
- BT & BW

4/16/09

USTec

- PMT sleeve
  drawing to Jim
- BC422

4/17/09

GRIShield presentation to Mack/Young/Schmitt

MCNP timing predictions
GCD-1 variability
✓ BR in rad-hydro
✓ AT ratio
✱ Measured bkgnds to Mark
Analyze URF's from Trident for ring reproducibility

[redacted]

4/20/09

VTC Sim Cam - Edmund, McKinnon

5/7 - First Campaign Review
5/25 - Final "
5/21 - test shot

VTC 8-10 Tues
NSTec/LO - 606-1206
/SB - 606-1204
LANL - 6-1203

Small Conf Rm
204 upstairs
COB Bldg 175
8 am

MZ CDR

4/22/09

20m V analysers

LaCave access

No access on Mon

- training records

Trap ~~#~~ 121,44-0327

Joy Ih travel -

- exclude ~~#~~ 28-31

27, 4th - .75

* Kurnitt of Haz Mat

[redacted]

9/23/09

NSTec

streak camera optics from Parvin
BC422

Barb Quiroga?
925-784-6517

Colton
Wayne Babitch - Hockey Pucks
$CaCO_3$

Joint Exp Drug Unit JEDI

Relocation
Jennifer Chavez 54484

Andy McKinnon
925 424 2711

Jerry
~~ICOPS OMNI~~

$147 Govt $249 reg
$199 non govt $1520
40000 909757
3 dys prior

200uCi
~20%

GRH-15m CDR 4/30/09

200ps thru single MCP 4mm

BC422 - P-23, STL

18 3/4" for cones

LLNL

- names

Don Cavanagh - gas systems

"ton at a meter" cantilever

Safety note - Scott Winters

OMT SS to Rich / Rocky

Smurf tubing for fiber conduit

AWE scope next FY in Apr 10?

0 or 180° for maintenance

90, 15 cryo tarpus

64, 241 - not great

136 - may be good

GMT 5/4/09

- GRH-15m
- Scopes

- UL/ESO listed equip

MZ 180° phase shift

$V = IR$

$200 \times 10^{-9} C$

$V = \frac{200 \times 10^{-9}}{150 \times 10^{-12}} 50$

$\frac{1.7 \times 10^{-10} \, Vs}{50 \Omega} = 3.4 pC$

~~$C = V \cdot fwhm$~~

$Vs = CR$

$V = \frac{C}{fwhm} R$

$C = \frac{40 \cdot 200}{50}$

Ignition VTC 5/7/09

GRH Sun Comm Aug 7 → Jun 7
Blue test shot 5/18

Commissioning Shots (Sangster)
~25 Shots
10 - 100 ps Au ball x-ray timing
6 - D/3He ≥10^{10} p
9 - DT 10^{14}-10^{15} n

Modeling

- URF variation
- Xray response?

NIF ports 64°
5° - open w/ crane overhead } pipes
20° - open } underneath

925-663 0156

[redacted]

CDR/PDR - early Jun
- models.
- Outline plans
- Electrical one lines
* Send one-liner to Barb

Mike Reinhardt - Conduit layout
Electrical Assoc.
Tony Lee - diagnostic drawing
* debris shields
* mounting holes

High Yield next year
- Drane, Drag Dev 1st Q

~~GMT~~ 5/11/09
- GRH Funding
- Drag Dev

- Essential personnel - forgho for IEC
- Privileged FN's
* Keys from Rosada/Swift

Yolanda Sanchez 5/11/09

BC 422

PAWE - Garbett response

~~URF Anal~~ → Aaron * W OAP

~~* Travel~~ ~~POAR~~

Laser Trng E8AD

** DPO Scopes PR IFSA

Malone IFSA LAUR

Conduit ?

** COS, ET, FT

~~* Pcode Jane AFP~~

GRH-15m

~~** 12 Shot Request C/S~~

Keys - Lou, Denman, Gibson

~~* POP Proof~~

MIT Contract

** FY10 Budget

McKinnon comp trng

DTRat Funding Req C-1,4,10

~~* WING~~

* Sim Comm Setup

~~** LWG/ICOPS LAUR~~

Mack contract

* Threshold curves to Doug / URF

Red Bead DLA

PBI

Omega Scheduling

Jul 28 - 100ps x-rays

Sep 2 - $1\text{-}3 \times 10^{13}$ n

Sep 30 } ~~Drag Dev~~

Oct 26 }

Dec 9 TIMC

10 Drag Dev ✓

No BT on Diagnostics list

GHS on theoretical support

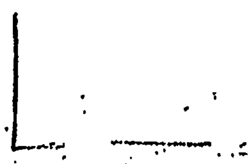
High yield - drug effect at 10^{15}

James 5/11/09

- Omega Chamber thickness
- p/c position

$c = 30\ m/ns$
$V_n = .5\ m/ns$

$t_w^n = \frac{1.7}{30} - \frac{1.3}{5} =$

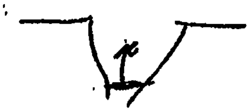


Null at ∅psia
Air Fluor

DPO Scopes
Warnes L437
925-424-4541
warnes1@llnl.gov

PMTs

thin 520 p/c
Max QE
SHV/sma/bnc
Shallower window
W can
Zeners
ND



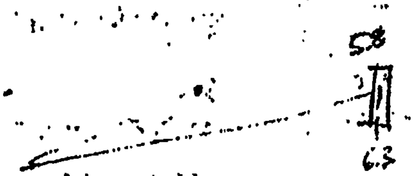
- 110-573 in GCD
- tape up fiber inputs

PMT LED test
cable diagram
PMT order

IEC water
GRH

GMT 5/18/09

- Electrical Safety
  - Anastasio memo - 4 actions
    - Ch. 2 Roles & Resp 5/29
    - Elec Trng 5/29
      - if not current → signed statement No Work
    - Qual Cards
- VTC Trng
- Publication lists CY 07-08
- Pager



$\Delta t \approx 160 \cdot 6.3 + 6.3 \cdot 33\,ps = 6.3(\cancel{160}\ 193\,ps)$

$\simeq 1.22\,ns$

$y = -\frac{x}{x_e}$ $x_e = -\frac{x}{\ln y}$

5/19/09

May 13, 14 Data Analysis
- BT, ~~BW~~ - gaussian fits to Fidus & DT-γ ch
- BW - bkgd ~~sm~~ sub
  decon w/ Trident '09 ORF

MCNP Runs

1. GRH 64, 136 } NIF ~6m
2. 5 } w & w/o cement (40cm)
3. (Bi crystal) 136 } Ω ~1.9m
4. 5 }

5 pin + chamber Ω ✓ n's, γ's
6 gxc + tangos. February (3+3)
7 6" back + box
1" Box

[redacted]

71254
Tek DPO70,000 catalog GSA
71254 B 12.5GHz $97.8k $87,318
71604 16 GHz 106,236
extended repair warranty (beyond 1yr)
3 yr - $5k - 1 time fee option R3
5 yr - $9k
w/o warranty repair ~ $12k

Jim Crane 505-239-6715
-borrow for July 28, w/ shipping case
19" rack kit ~$1.1k
spare hard drive $200

LLNL VPN-C
herrmann11, X€J3P18C
McKinnon
42711 response fcn 5ns
dew
Wilson5@llnl.gov
1-25 MeV 20 MeV sens
6 MeV ~ 1e-2
9 5e-3
15 1e-3

NSTec 5/28/09

- LUNA timing of Roll laser light
  Chanter light link
  ~~need to remove flatness~~
  Zaheer or Scott

- GoS - Request Letter
  Addressed to DL or AD
  - program $, audit likely
  - cost estimate, Abney
  - Alison Gilstrap - conflict of interest
  - Patricia Stevens - NA's Sec Office

Yolanda Sanchez
5-2130

Jonathan Ventura PAD AWE Costoff
606-0170

GMT 6/8/09

LPUAR - Yongho

LTR - Aaron.

Chpt 2 signature - ~~George & John~~, Klare
Carl, Joe, Dennis, Lou

~~Ethec Safety~~ walk thru

LARPA-E ?

PERFORM - input by Friday, to 6/30

Packs 6/10/09

$CaCO_3$, Ca reacts w/ water

~~PADWP~~ Sylvia Martinez 665-2973

sylvia@lanl.gov

movers - lease 11/09
advance - ~~payson~~
vehicle - lane

NSToc/NIF UTC 6/11/09

- MZ purchase in July
- 20ps ~~[illegible]~~ laser diode
- borrow FTD's from DANTE
  70604 6GHz Scope available for GRH
- Ni - activation concern
  Au, Chem film
- 64, 20
- CDR
  - Prototype overview
  - Omega Results (Glimmer)
  - FMA
  - Risk Mitigation
  - Other Reviews
  - Problems
  - Procurement
  - Assembly, Fab plans
  - Schedule
  - Calibration Plan
  - Installation & Op Plans
  - Cost Sum
  - Req's
  - * SDR update

- Verification method (SDR)
  In-situ dry run, Commissioning
- Interface req's
- CAD validation
- Physics
- Block diagram
- System layout
- Concept of op
- ~~Cuber~~ Materials (Nb Ni, Mo)
- Safety Notes

≤ 3 hrs

S. Bartha budgeting 9/12/09

is Carl forecasted ? 25%

Why is labor forecast higher for last 1/3 yr?

Nancy Spreadsheet

Check M/E space on each Z-coder

JL/H for half my salary

$200 K salary

$100 K travel COS

Billy Butler/Grim - Streak cameras

* Task list for FY10 for WP (4 tasks)

- deliver channels { 1st 2 in Oct, 2nd 2 in Dec }
- commission

IQ, OQ Labor & M+S

Ventura CoS 6/12/09

AD approval

* LLNL letter of invitation

LLNL supervisor ? – John

LANL org ? – Joan Elson – EPS
Pam French

* Task Agreement

Batha (cont) 6/12/09

– Duke, Macks

FY 10 ≤ $1M for GRH-15

– Turned to LLNL in July

JB

9/12/07

Wilson

~~[illegible]~~

2,53×10^14 DT-n ~~2~~×10^-5 = 5×10^9 γ's
6.39×10^9 ~~TP~~ thermal γ's
4.32×10^7 knockon γ's
1.1 ×10^12 C12 γ's ~~25~~ > DT γ's

* Ω validation
* Conv eff's
No 12 MeV line in the code
* TR
* Spectral exp't
14 & 16 w/ 2-stage PMT

2,962
78

1/20/09

~~LANL Pu ID → Glen~~
~~MST-7 funding~~
IEEE Review
* SRF's
*✓ TRF
~~* Foreign Nat'l Access~~
Hsu badge
~~* Travel~~
* PoP revision
Jamie laptop
✓ laptop battery
* Highlights → Bertha
PMT cross cal
~~* Targets to Vladimir~~
* LLE visit req - Schmitt
* PerforM
PMT cals @ Trident ?
NSTec AFP
Edwards GRH memo
ICOPS sponsorship
$5k from JLDE, JLIM
Meetings & Doug
Codes

Yolanda Sanchez 5/11/09

BC 422

PAWE - Garbett

~~URF Anal~~ → Aaron * W OAP

~~* Travel~~ ~~PUAR~~

Laser Trng EBAD

** DPO Scopes PR IFSA

Malone IFSA LLUR

Conduit ?

** COS, ET, FT

~~* P code June AFR~~

GRH-15m

~~** 12 Shot Request C/S~~

Keys - Lou, Dewson, Gibson

~~* Pol Proof~~

MIT Contract

** FY10 Budget

McKinnon comp trng

DTRot Funding Req C-1, 4, 10

~~* TWIG~~

* Sim Com Setup

~~** LWG/ICOPS LLUR~~

Mack contract

* Threshold curves to Doug / URF

Xerox 7665

128.165.120.100

862-7773

Paul Beal Dot
PBI

EXHIBIT G

Woods Oviatt Gilman LLP

Attorneys

700 Crossroads Building
2 State Street
Rochester, New York 14614

Tel: 585.987.2800
Fax: 585.454.3968
www.woodsoviatt.com

Writer's Direct Dial Number: 585.987.2812
Writer's Direct Fax Number: 585.987.2912
Email: gkolcon@woodsoviatt.com

October 10, 2012

Hon. Jonathan W. Feldman
United State District Court
2330 United States Court
100 State Street
Rochester, New York 14614

Re: Samuel Roberts v. Los Alamos National Security, LLC, et al. v. University of Rochester
Civil Case No.: 11-cv-6206(L)

Dear Judge Feldman:

As the Court is aware, plaintiff's counsel previously filed a motion to compel discovery from Defendant Los Alamos National Security, LLC, and that motion resulted in an Order directing Los Alamos to take certain steps. Los Alamos filed the items delineated by the Court's Order. However, plaintiff's counsel remains dissatisfied. Los Alamos has set forth its technical abilities to conduct various types of searches for electronic data as set forth in the filed affidavits. To the extent that the plaintiff is seeking further discovery, Los Alamos is both capable of and willing to have an electronic search of data conducted, and Los Alamos has offered to Mr. Micca to conduct such searches if there are specific search terms that the plaintiff would like utilized for purposes of conducting an electronic search. Plaintiff's counsel has declined to participate in any cooperative discussion regarding this process, but instead has opted to file a motion for contempt. Los Alamos is not resisting production of discovery, and is even willing to allow electronic searches of its system to be completed without any cost allocation to the plaintiff. At this point, we respectfully submit that a judicial pretrial conference may be helpful to address any outstanding concerns that plaintiff's counsel may have regarding discovery and to provide direction to Los Alamos as to what further steps, if any, the Court can recommend.

We appreciate the Court's consideration.

Respectfully submitted,

WOODS OVIATT GILMAN LLP

Greta K. Kolcon

GKK/alb

{1623646: }

cc: Louis J. Micca, Esq.
David Rothenberg, Esq.
Christine Tramontano, Esq.
Eric J. Ward, Esq.

EXHIBIT H

Possible Roberts Search Terms

light pipe
light-pipe
shot day
shot-day
high yield neutron temporal diagnostic
HYNTD
Omega
DT Rat
DT Ratio
DTRat
DTRat Campaign
preshot
pre-shot
Cherenkov
Gas Cherenkov Detector
Cherenkov Detector
Target Bay
mounting bolts
epoxy
DT implosions
target chamber
"La Cave"
shot 9
9th shot
Deuterium/Tritium Ratio
Primary Diagnostic
Secondary Diagnostic
Ride Along Diagnostic
University of Rochester
LLE
LP
lightpipe

Date of August 6, 2008 (date of accident)

Individual Names to be Searched

Hans Herrmann
John Oertel
Scott Evans
David Clark
Jonathan Workman
Cris Barnes
Vladimir Glebov
Johan Frenje
George Kyrala
Sam Roberts

Samuel Roberts
Zaheer Ali
Colin Horsfield
Mike Moran